Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

FEBRUARY, 1950

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Ohio Rolls

SHAPING METAL FOR ALL INDUSTRY

MEET PRODUCTION DEMANDS

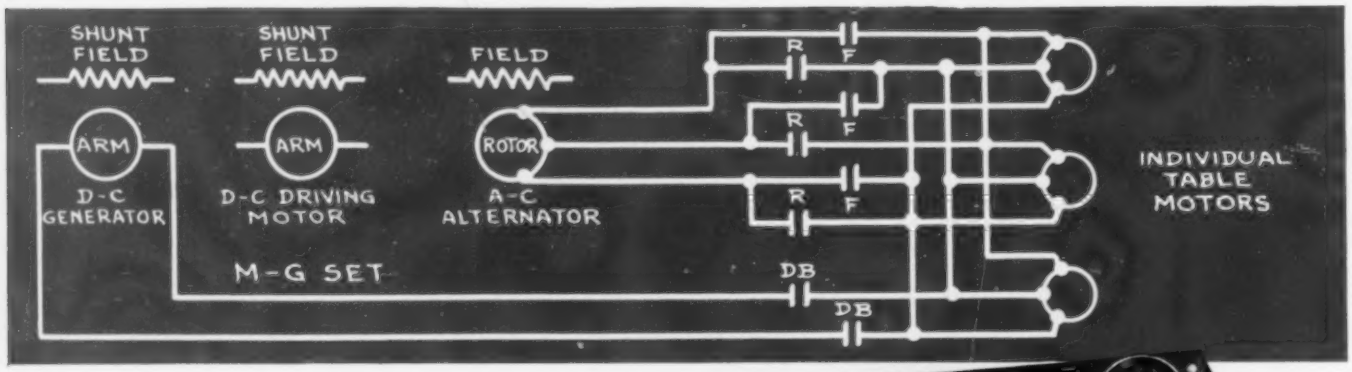
More, more, more . . . in less time . . . is the steel business today. Meet and beat demands with Ohio Rolls. Get greater tonnage at lower cost. Ohio Rolls give you a production advantage.

Select from any of these eleven types of Ohio Steel and Iron Rolls: Carbon Steel Rolls, Ohioloy Rolls, Ohioloy "K" Rolls, HOLL-O-CAST Rolls, Chilled Iron Rolls, Alloy Chilled Iron Rolls, Denso Iron Rolls, Nickel Grain Rolls, Special Iron Rolls, Nioloy Rolls, Flintuff Rolls.

THE OHIO STEEL FOUNDRY COMPANY—LIMA, OHIO

PLANTS AT LIMA AND SPRINGFIELD, OHIO

What control for what mill equipment? One of a SERIES of advertisements featuring basic heavy duty power circuits . . . and showing Cutler-Hammer's broad design and application experience which has made it the preferred control for the steel industry.



In an installation requiring individual squirrel cage motors supplied by an adjustable frequency motor generator set...

Let your choice be a . . . . . CUTLER-HAMMER Custom-Built Adjustable Frequency Control

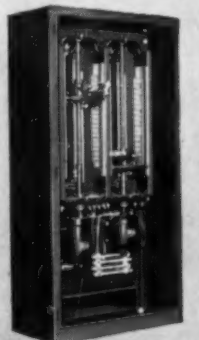
Individual motor drives have proven their superiority for hot strip mill runout table rolls. Where squirrel cage motors are used with an alternating current adjustable frequency motor generator set, Cutler-Hammer control specialists have developed an adjustable frequency controller that provides any combination of the following functions:

(a) Starting by frequency control, all motors being connected to the alternator at low frequency and accelerated by raising the frequency.
(b) Group starting, i.e., by connecting successive groups of motors to the alternator which is running at operating frequency.
(c) Field forcing of alternator for maximum starting torque.
(d) Changes in linear speed of the hot strip by adjusting the frequency of the alternator.
(e) Jogging forward or reverse.
(f) Quick stop by plugging or by applying low voltage direct current to one phase for dynamic braking.
(g) Pre-selection of running speeds.

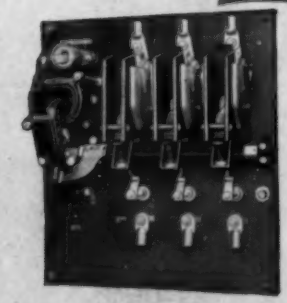
For further information, write CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

CUTLER-HAMMER MOTOR CONTROL C-H

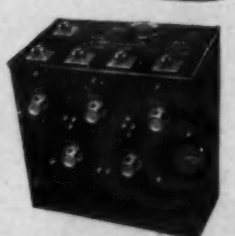
Typical Components of CUTLER-HAMMER Mill Control



Rheostat for adjustable frequency controller



300 Ampere A-c Magnetic Contactor



Control desk with sloping top and slanted front.

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 27, No. 2.

SPECIALISTS IN SMALL ROLLS for

TUBE · PIPE ROD · STRUCTURAL

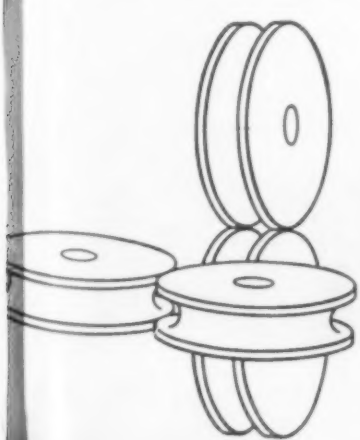
BAR · BILLET

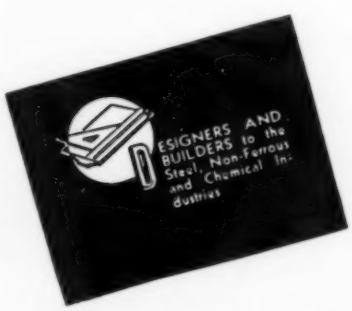
Small rolls have been an important specialty of Aetna-Standard for 36 years . . . for a very good reason.

Aetna as designers and builders of most of the world's seamless tube mills and continuous butt weld pipe mills, has naturally developed roll technique and facilities towards small rolls. Consequently, our foundry is equipped and our facilities are especially adapted for the manufacture of small rolling mill rolls. For example, Aetna roll foundry had to develop a special roll for their new continuous butt weld pipe mills, which now are producing small diameter pipe at speeds up to one thousand feet per minute. Our roll specialists work together with our engineers during the development stage of a mill.

Aetna-Standard has a long record of experience in making small rolls.

★





THE AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN, OHIO
ASSOCIATED COMPANIES
AETNA-STANDARD ENGINEERING CO., LTD., TORONTO, ONTARIO, CANADA
HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
SOCIETE DE CONSTRUCTIONS DE MONTBARD, 6 RUE DARU, PARIS (8e) FRANCE

TYPES

PLAIN CHILL	ALANITE
SAND IRON	ASEX GRAIN
MOLY CHILL	ASEX SPECIAL

NICKEL CHILL

What About PERFORMANCE?

The best proof of National Rolls performance is their use for over forty years by leading steel producers.

Their dependability on the stands has its beginning at National at the initial step of production. All raw materials that go into National Rolls are carefully analyzed and checked in National's laboratories. This same care is adhered to in every step of production through final inspection.

Quality control plus National's long years of experience in metal casting and precision finishing means durable, dependable performance on your stands. Try them and see.

ARE YOU RECEIVING YOUR COPY OF "THE NATIONAL ROLL"?
In our quarterly publication, we are running a series of articles on conditions of the industry in foreign countries and another series on metallurgical research in colleges and universities in this country. Let us put you on our mailing list. Just send us your name and address.

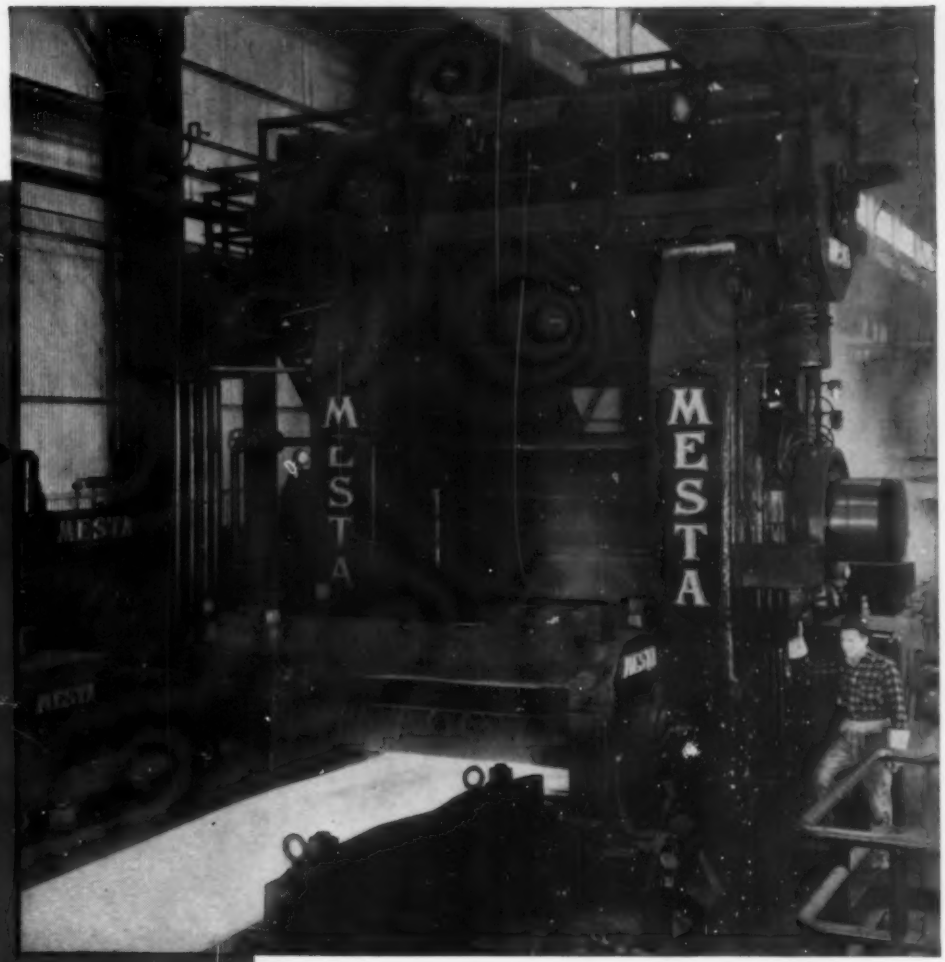
National Rolls

THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

SPECIALISTS IN IRON AND ALLOY IRON ROLLS AND CASTINGS

Mesta Machine Photo



Fully Protect Your Roll Neck Bearings

Use TEXACO REGAL OILS

Put *Texaco Regal Oil* in the circulating system and assure a constant flow of clean, cool lubricant to oil film roll neck bearings. This means smooth, trouble-free performance . . . uninterrupted production . . . longer bearing life . . . lower maintenance costs.

Texaco Regal Oils are turbine-quality oils with exceptional resistance to oxidation, emulsification and sludging. Water that may get in them quickly separates out. They keep bearings and oil lines *clean* . . . carry heavy loads easily . . . even under high-operating temperatures.

For full protection of heavy-duty enclosed gears, use *Texaco Meropa Lubricants.* They have especially high load-carrying capacity, high resistance to foaming . . . assure longer life for both gears and bearings.

Let a Texaco Lubrication Engineer give you full particulars . . . help you step up efficiency, step down costs throughout your mill. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO Regal Oils
(HEAVY CIRCULATING OILS)

TUNE IN . . . TEXACO presents **MILTON BERLE** on television every Tuesday night. **METROPOLITAN OPERA** radio broadcasts every Saturday afternoon.

Continental

Designers
and Builders of
Complete Rolling Mills
and Auxiliary Equipment

SPECIAL

ALLOY BAR MILLS

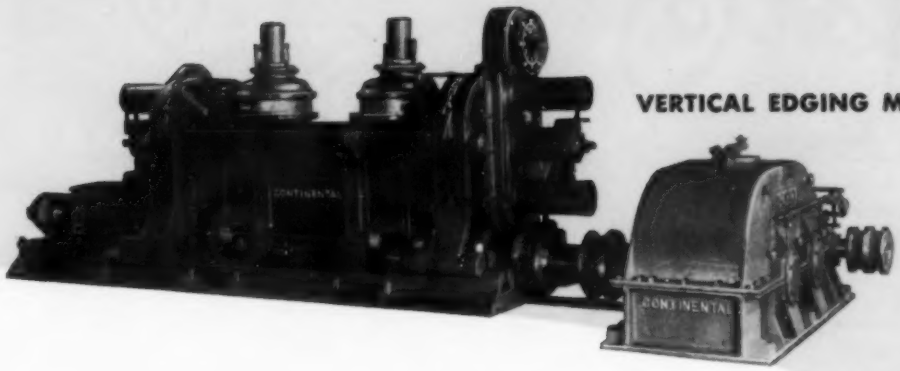
PRODUCERS OF: Complete Rolling Mill Installations including:

Blooming Mills	Plate Mills	Non-Ferrous Mills	Tables
Structural Mills	Slabbing Mills	Roll Lathes	Transfers
Bar Mills	Universal Mills	Ingot Mold Cars	Shears and other auxiliary steel plant equipment
Billet Mills	Hot Strip Mills	Charging Box Cars	
Merchant Mills	Cold Strip Mills	De-Pilers	

IRON, ALLOY IRON and STEEL ROLLS for ferrous and non-ferrous rolling mills; pulp and paper industry; textile industry; and milling, cereal and vegetable oil industries.

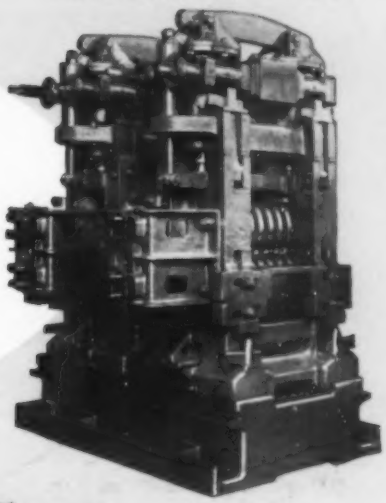
* * *

CARBON and ALLOY STEEL CASTINGS from 20 to 250,000 pounds. Complete heat treating and machining facilities.

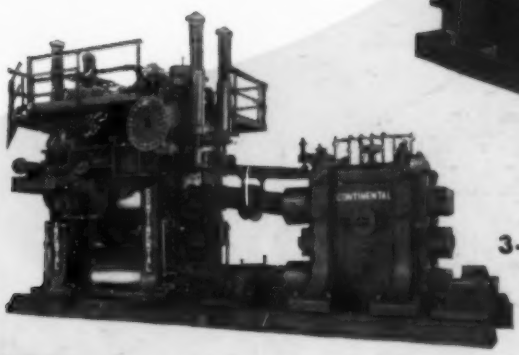


VERTICAL EDGING MILL

PRECISION ROD MILLS

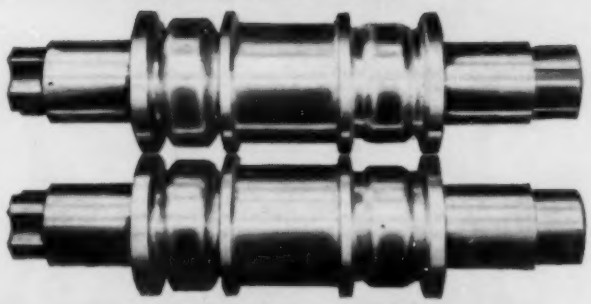


MILLS for specialized products



3-HIGH ALLOY PLATE MILL

IRON, ALLOY IRON and STEEL ROLLS



LARGE and/or INTRICATE STEEL CASTINGS

Continental
FOUNDRY & MACHINE CO.
CHICAGO · PITTSBURGH
Plants at: East Chicago, Ind.; Wheeling, W. Va., Pittsburgh, Pa.

Continental

7 Reasons-

THEY'RE ADAPTABLE!

Pillow blocks available with fixed or floating bearing. (Fixed bearing shown)

THEY CARRY THEIR FULL LOAD!

Self-aligning double row of concave rollers between convex raceways provide full contact, full load capacity, even with shaft deflection or misalignment.

CLEAN OPERATION

Effective seal keeps grease or oil in, dirt out!

FEWER GREASINGS!

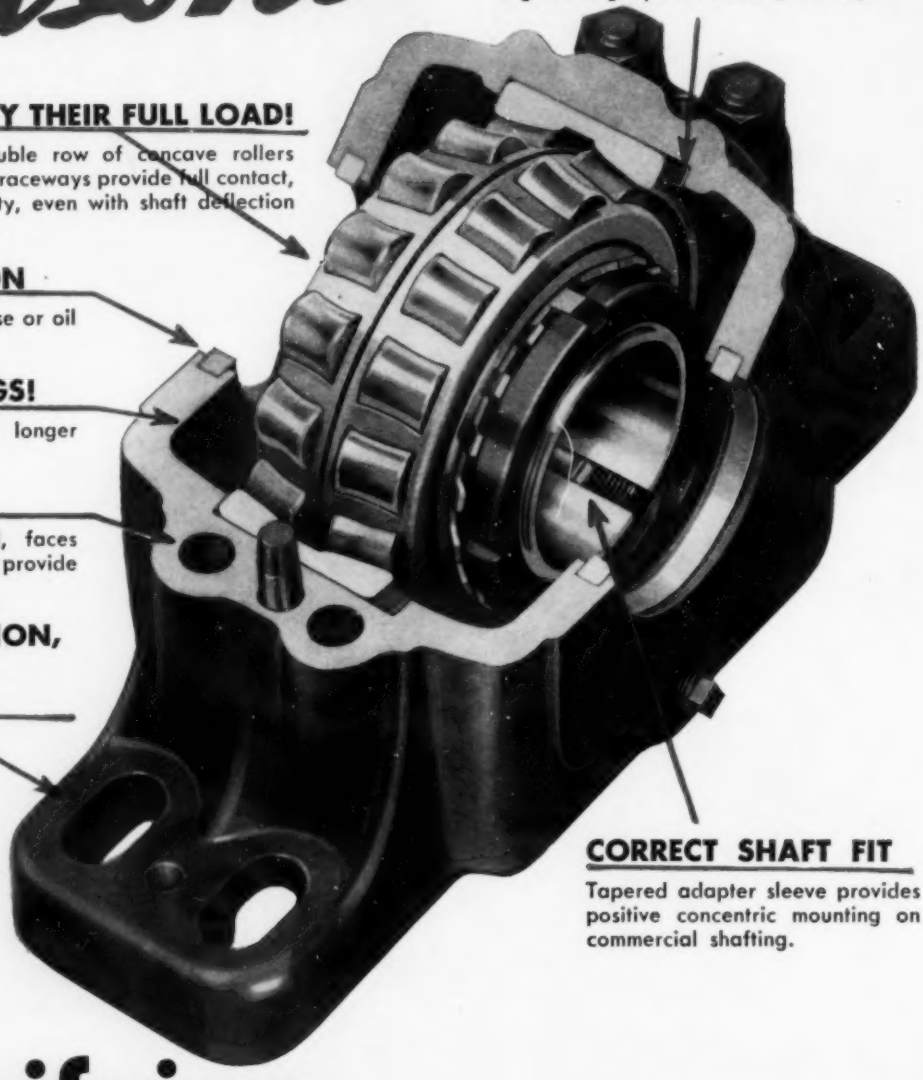
Large reservoir allows longer greasing intervals.

PRECISION FIT

Base and cap doweled, faces accurately ground, to provide leak-proof joint.

EASY INSTALLATION, INSPECTION, DISASSEMBLY

Rugged, two-piece cast housing is simple, with slotted bolt holes for easy mounting.



CORRECT SHAFT FIT

Tapered adapter sleeve provides positive concentric mounting on commercial shafting.

for Specifying

Better and longer service are your prime considerations in choosing such vital equipment as ball and roller bearings. Every feature of Link-Belt bearings is calculated to contribute to their efficiency and endurance. The engineering knowledge of the Link-Belt organization and the unexcelled facilities of a plant devoted entirely to manufacturing precision ball and roller bearings are your assurance of maximum service.

Illustrated above is Series 6800 Roller Bearing Pillow Block, tapered adapter sleeve type; also made in Series 7800 and 7900 press fit type for precision shafting. Other standard models are available in ball and roller bearing types, for various shaft sizes, solid or split housings, open or closed ends, in pillow blocks, cartridge, flanged cartridge, flanged, hanger and takeup blocks. Available from stock at factory branch stores and distributors located throughout the nation and many representatives in other countries of the world.

Complete data in Catalog 2550. Send for your copy.

LINK-BELT
Self-Aligning
BALL and ROLLER BEARINGS

THE SYMBOL OF QUALITY · LB · LINK-BELT

LINK-BELT COMPANY 11,733

Indianapolis 6, Chicago 9, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Pittsburgh 13, Seattle 4, Toronto 8.
Offices, Factory Branch Store and Distributors in Principal Cities.

MESTA

BACKING-UP ROLLS FOR FOUR-HIGH HOT AND COLD MILLS

DESIGNERS AND MAKERS OF COMPLETE STEEL PLANTS

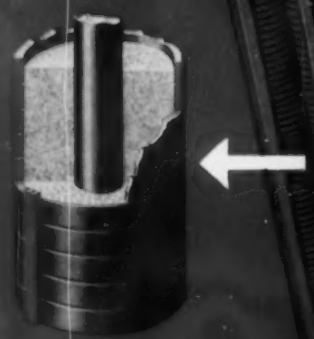
MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Mesta 59" x 130" Heat Treated Special Allo
Steel Backing-Up Roll Being Finished in a 60
Mesta Heavy Duty Roll grinder.

EXIDE-IRONCLAD PLATES *are DIFFERENT*

EXCLUSIVE Positive Plate showing slotted tube construction.

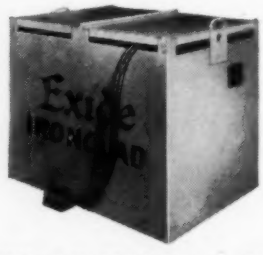


Enlarged cutaway view of section of tube containing active material. So small are the slots that, while permitting easy access of electrolyte, they retard the active material from readily washing out or jarring loose.

The famous and exclusive Exide-Ironclad positive plate is the result of sixty-two years of battery-building experience. During that time we have learned much about the design and construction of every type of battery for every application. Development work never ceases in improving the performance of Exide-Ironclad Batteries. Our research staff is the largest in the industry. Engineers, chemists, metallurgists, physicists, technicians and their aides, equipped with all the necessary tools and devices, are constantly building and testing various types and kinds of plates and assemblies.

We have yet to find a positive plate with all the desirable characteristics of the Exide-Ironclad for use in battery electric industrial trucks. Further proof of its superiority is supplied by long service records in thousands upon thousands of installations.

Exide-Ironclad Batteries provide high power ability, high electrical efficiency, ruggedness, long life, minimum maintenance. The combination of these Exide-Ironclad characteristics assures years of dependable day-in, day-out service . . . *at lowest cost.*

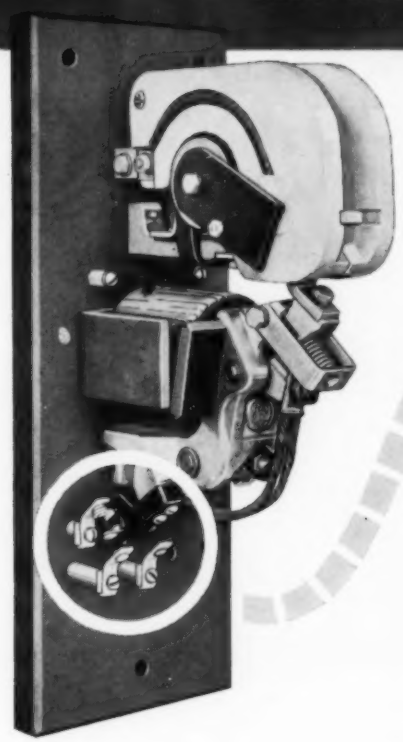


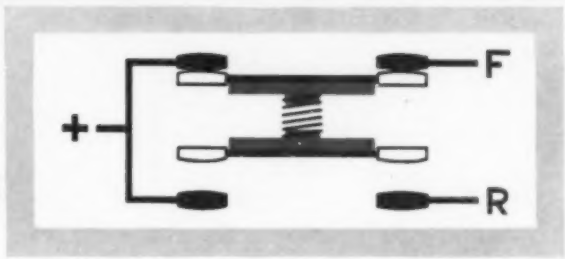
THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

1888 . . . DEPENDABLE BATTERIES FOR 62 YEARS . . . 1950

"Exide-Ironclad" *Reg. Trade-mark U.S. Pat. Off.*

Safer Electrical Interlocking on All EC&M *LINE-ARC* CONTACTORS





Two sets of double-break contacts—isolated from each other—no carry-over from one to the other by an arc.

A Good Reason for Specifying E C & M Magnetic Control

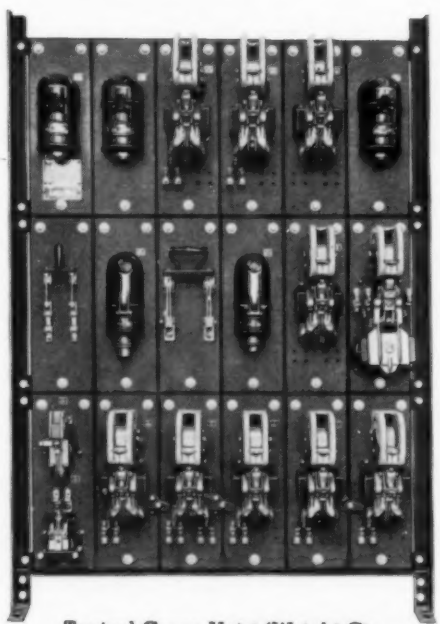
Magnetic contactor controllers use electrical interlocks to maintain safe motor connections, to regulate sequence of contactor operation, and for other important functions that promote efficient operation of motors or of control or of both motors and control.

On controllers using the EC&M *improved* LINE-ARC Contactors, a NEW Interlock provides *safer* interlocking with *lower* maintenance. The new upper and lower stationary contacts have double-faced contacts which can be moved from one position to the other for double the wear.

Movable contacts, carried in an insulated slotted frame attached to the contactor arm from the front, are easily inserted or removed without tools. The normally-open contact bridge is *isolated* from the normally-closed bridge by two insulators (shown in red in the sketch above). These insulators keep the spring in alignment and *prevent* the spring from carrying current from one bridge to the other.

Coin-silver contacts are used on these new electrical interlocks. With two movable contact bridges (instead of one previously used) and each *isolated* from the other, normally-closed circuits *cannot be carried over* by an arc to *normally-open* circuits or vice versa.

Safer electrical interlocks—a good reason for specifying EC&M Magnetic Control.



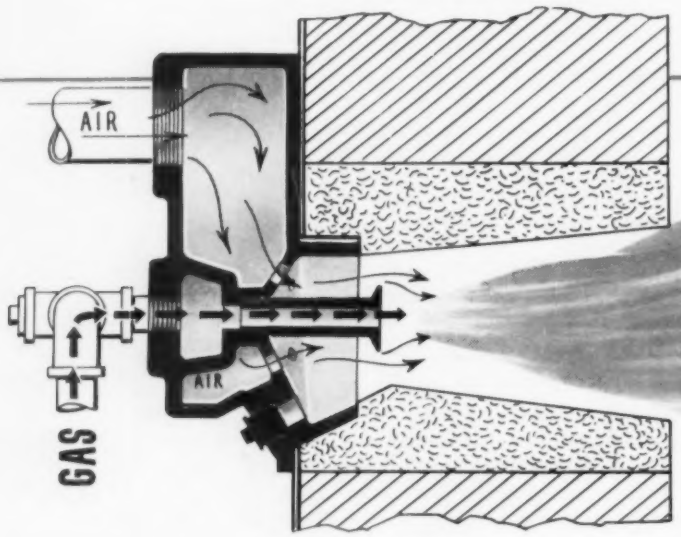
Typical Crane-Hoist (Wright Circuit) Controller with improved *LINE-ARC* Contactors.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

GET MORE from your furnace! MORE from your fuel!

BLOOM BURNER

TEMPERED-FLAME

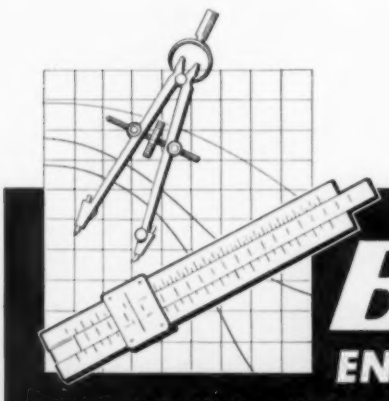


GREATER ***Flexibility***—Furnace temperatures as low as 400° F. or as high as 2450° F. can be obtained and maintained without difficulty. The Tempered Flame Burner will light at full capacity, and will burn as long as it has fuel.

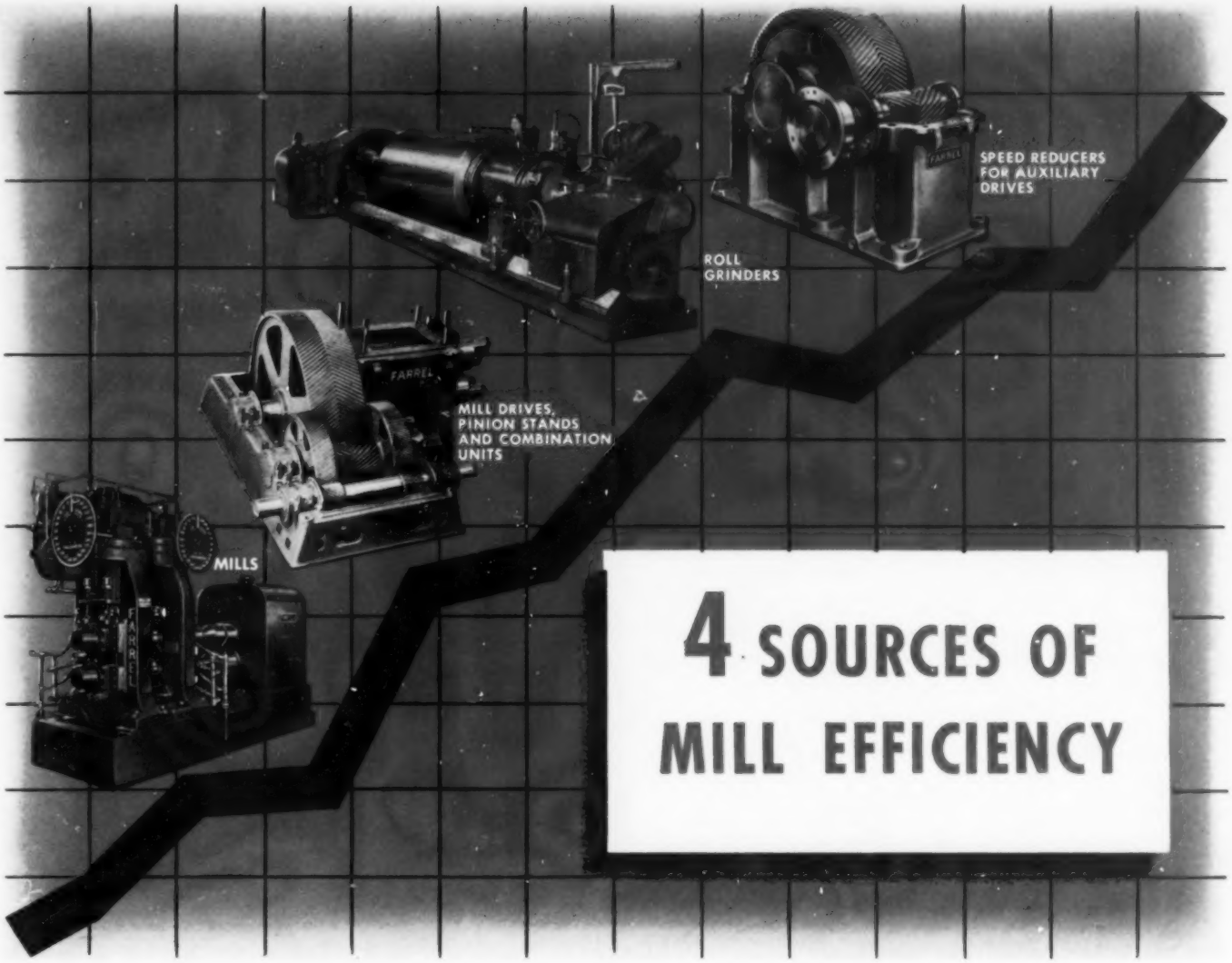
UNIFORM ***Temperature***— With this Bloom burner, the desired temperature can be readily maintained uniformly throughout the furnace chamber.

FASTER ***Heating***—Accomplished because cold spots are eliminated. Thus the time of annealing cycles is reduced.

Write for bulletin giving full details of the Bloom Tempered Flame Burner.



BLOOM
ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 12, Pa.


SPEED REDUCERS FOR AUXILIARY DRIVES
ROLL GRINDERS
MILL DRIVES, PINION STANDS AND COMBINATION UNITS
MILLS
4 SOURCES OF MILL EFFICIENCY

For close to a century Farrel engineers have specialized in rolling mill equipment, designed to improve the efficiency of metal production.

MILLS are built in a wide range of sizes for rolling nonferrous rods, strips or sheets, metal foils and cold strip steel. Farrel also designs and manufactures coilers and special handling equipment required to make each installation a complete production unit.

MILL DRIVES, PINION STANDS AND COMBINATION UNITS are specially designed to suit individual requirements. Single, double and multiple reduction gear units are available in a wide range of ratios and capacities. Pinion stands with single or double helical pinions are built in any size, for any capacity. Combination units include reduction gear drive and pinion stand in a compact, integral housing.

ROLL GRINDERS are available in two types and nine standard sizes. These machines grind rolls with a perfect surface, free from marks of any kind, either straight, or with concave or convex contours of exact symmetry and accuracy.

SPEED REDUCERS FOR AUXILIARY DRIVES — These units are available in a wide range of ratios and capacities. Designs include single, double and multiple reduction units; speed-change units; right-angle drives and drives to meet special requirements.

Information and engineering consultation available, without obligation.

FARREL® ROLLING MILL MACHINERY

Rolls • Rolling Mills • Rod Mill Tables and Manipulating Equipment Universal Mill Spindles • Rod Coilers • Gears • Mill Pinions • Pinion Stands • Gear Drives of any Capacity • Flexible Couplings • Roll Grinding Machines • Roll Calipers • Lead Presses for Pipe or Rod.

FB-573

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston Pittsburgh, Akron, Cleveland, Detroit, Chicago, Los Angeles, Tulsa, Houston

Farrel-Birmingham®

Here's How to Erase Smoke Troubles

VIOLATION OF SMOKE ORDINANCE

LOSS OF FUEL ECONOMY

BAD COMMUNITY RELATIONS

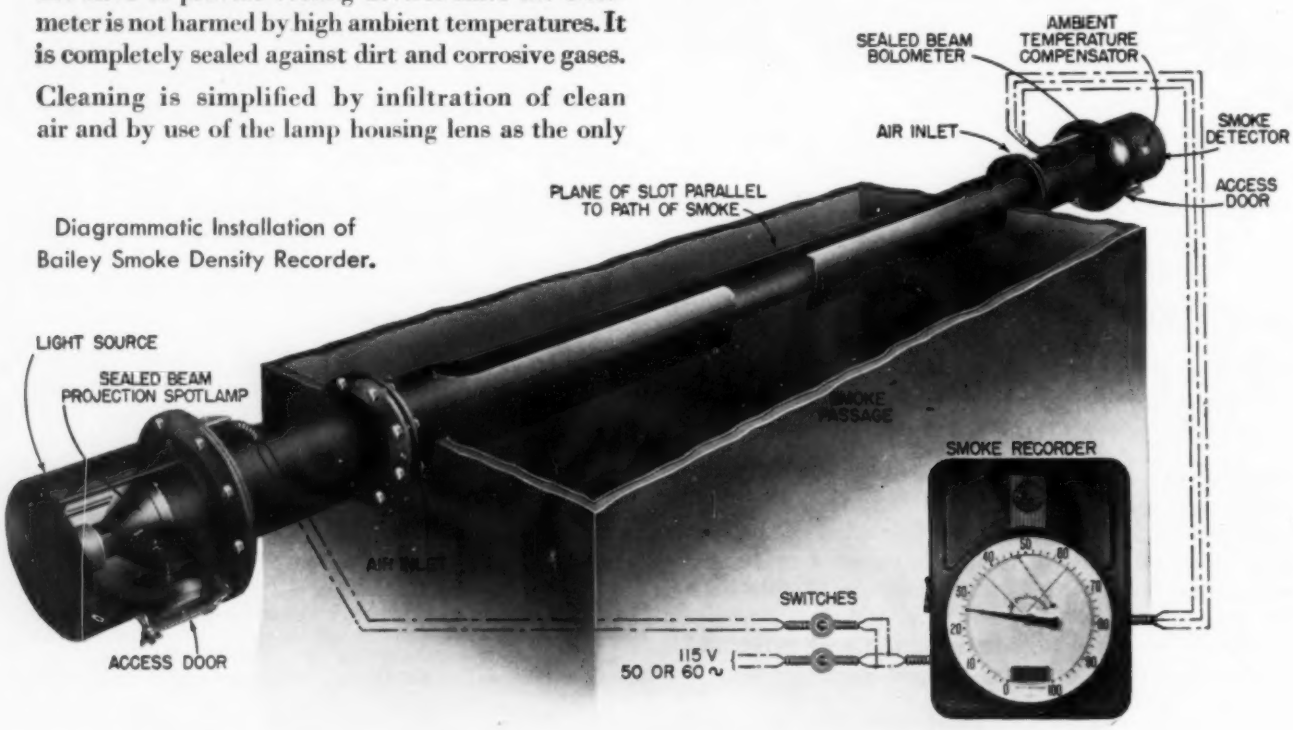
★ One of your first steps in erasing these troubles which result from excessive smoke, should be the installation of a Bailey Smoke Density Recorder. This 24-hour recorder is not an ordinary photo-cell instrument. Instead it detects smoke density by a Bolometer which is simply a sturdy tungsten filament and a parabolic mirror, mounted in a standard sealed beam automobile head lamp housing.

In using this simple, unique smoke detector, you do not have to provide cooling devices since the Bolometer is not harmed by high ambient temperatures. It is completely sealed against dirt and corrosive gases.

Cleaning is simplified by infiltration of clean air and by use of the lamp housing lens as the only window between the Bolometer and the gas passage.

It's easy to secure and maintain alignment of the sealed beam light source with the Bolometer since they are mounted at opposite ends of a slotted pipe which extends across the smoke passage.

For complete information on how you can profitably use this unique instrument to erase your smoke troubles, ask for Bulletin 211, "Bailey Smoke Density Recorder".



Diagrammatic Installation of Bailey Smoke Density Recorder.

G-29

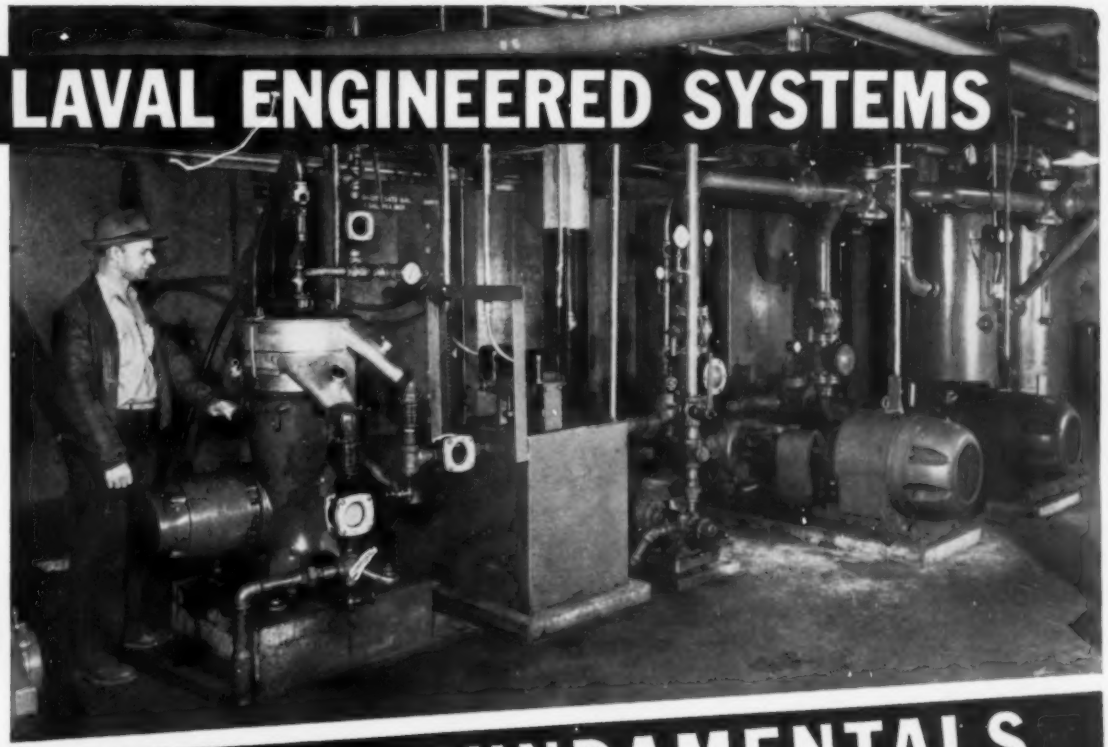
BAILEY METER COMPANY

1047 IVANHOE ROAD, CLEVELAND 10, OHIO • BRANCH OFFICES IN PRINCIPAL CITIES

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

Let Bailey Smoke Density Recorders Watch Your Stacks

ON DE LAVAL ENGINEERED SYSTEMS



DETAILS AND FUNDAMENTALS ARE BOTH IMPORTANT!

In laying out a steel mill lubrication job, it is important to design it in such a way that all fundamentals of mill lubrication systems are observed. To apply enough lubricant in the right places . . . to meter the lubricant correctly . . . to control temperature efficiently and to purify the lubricant adequately — such knowledge is basic. De Laval engineers have both the background and the equipment to make best possible applications of these fundamental principles.

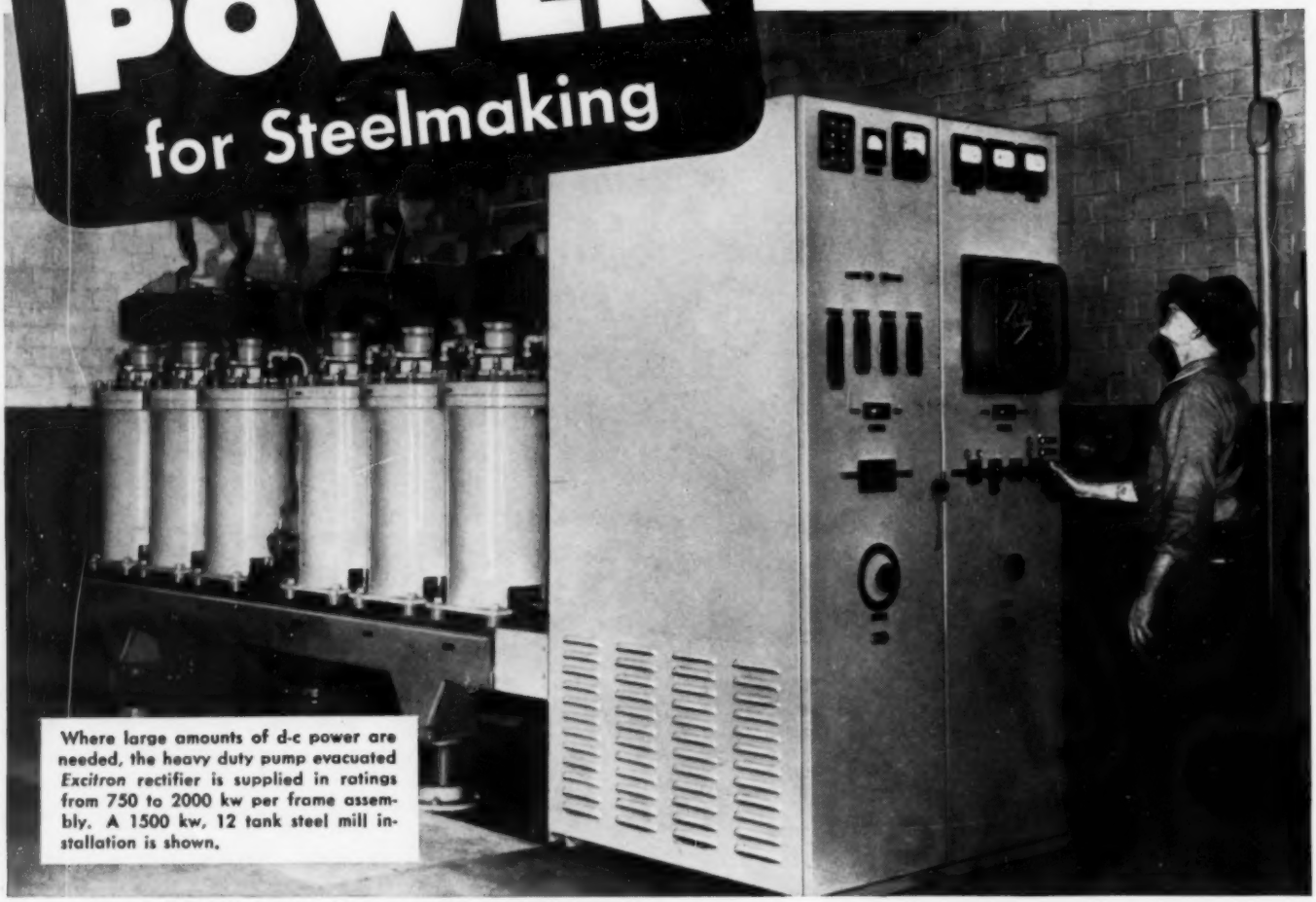
But "know-how" consists, too, of many details . . . derived from experience. And De Laval engineers know these fine points . . . know how to apply them so that each mill is most completely protected against lubrication trouble.

It makes no difference whether the mill is large or small — De Laval Lubrication Systems are custom-designed for all sizes.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, N. Y. 6 427 Randolph St., Chicago 6
DE LAVAL SALES & SERVICE, INC.
447 Fourth Ave., Pittsburgh 19
DE LAVAL PACIFIC COMPANY
61 Beale St., San Francisco 5

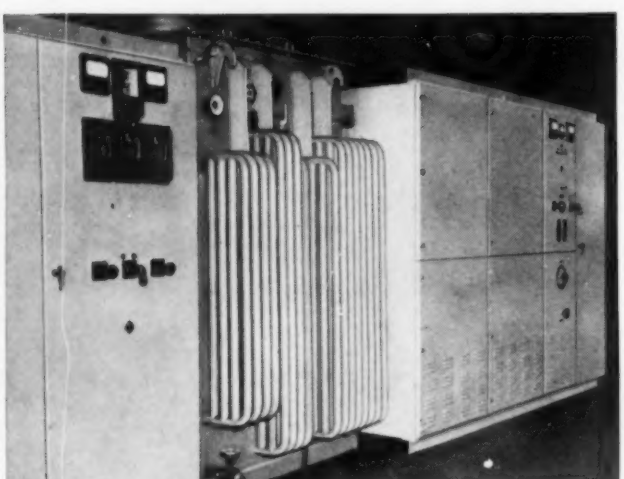
DE LAVAL ENGINEERED SYSTEMS

POWER for Steelmaking ...Where



Where large amounts of d-c power are needed, the heavy duty pump evacuated *Excitron* rectifier is supplied in ratings from 750 to 2000 kw per frame assembly. A 1500 kw, 12 tank steel mill installation is shown.

Excitron Rectifiers Convert a-c to d-c Where You Use It



For smaller ratings and smaller load centers, Allis-Chalmers builds the sealed tube, factory assembled and packaged *Excitron* rectifier in ratings from 200 to 500 kw at 250 volts d-c.

TODAY'S COST IMPORTANCE is speeding the use of mercury arc rectifiers to supply general purpose 250 volt d-c power for steel mills. *Excitron* rectifiers can readily be placed right at the true d-c load center. Long, power-wasting d-c feeders are eliminated and voltage regulation and distribubution efficiency are improved.

Excitron rectifiers are cheaper to operate and maintain than M-G sets. There are no problems of commutator and brush wear. No attendants are needed. Conversion efficiency is higher at all loads. Power savings are especially large where machine load factor is low and during long light load or idling periods.

A qualified Allis-Chalmers steel mill representative will be glad to further explain how *Excitron* rectifiers can benefit your operations. Call your nearest A-C sales office or write direct.

Power, Electrical, Processing Equipment for Iron and Steel

ALLIS-

and As You Like It!

These motor-generator sets support two 72-inch and one 54-inch temper mills at midwestern steel mill. Synchronous motors of 1750 hp, operating at 750 rpm, drive the generators.

Accurately Controlled Power Supplied to Temper Mills

HAVING FORTY-THREE temper (skin pass) mills driven and controlled by our electrical equipment is a record of which we're proud. And while temper mills are one of the more recent developments in steel rolling, Allis-Chalmers equipped temper mills date back to 1934.

That's *fifteen years* of experience in building controls and drives for single and two stand temper mills. They range up to 2350 hp with speeds up to 4250 feet per minute.

1750 HP Motor-Generator Sets

Pictured above is the recent installation at a midwestern steel mill, showing the motor-generator room for two 72-inch and one 54-inch single stand mills. Three 1750 hp a-c motors (at left in each bank) drive the d-c generators. *Regulex* control equipment (center and back) maintains automatic, accurate control of tension, speed, acceleration, and deceleration.

A-C Builds Both Drive, Control

It's good sense to work with a pioneer and a leader in any field. The former has more experience; the latter, a good performance record. Allis-Chalmers has both.

This combined experience in building the controls and drives of temper mills pays off! Quality construction and design are revealed by the flexibility and reliability of performance.

Allis-Chalmers equipment will fit smoothly into your production team. We would welcome the opportunity to give personal attention to your electrical requirements — whether generation, switching, conversion, rectification, drive or control. A-C offices in most major cities.

A-2943

ALLIS-CHALMERS, 1020A SO. 70 ST.
MILWAUKEE, WIS.

Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

PLATE HANDLING CRANES

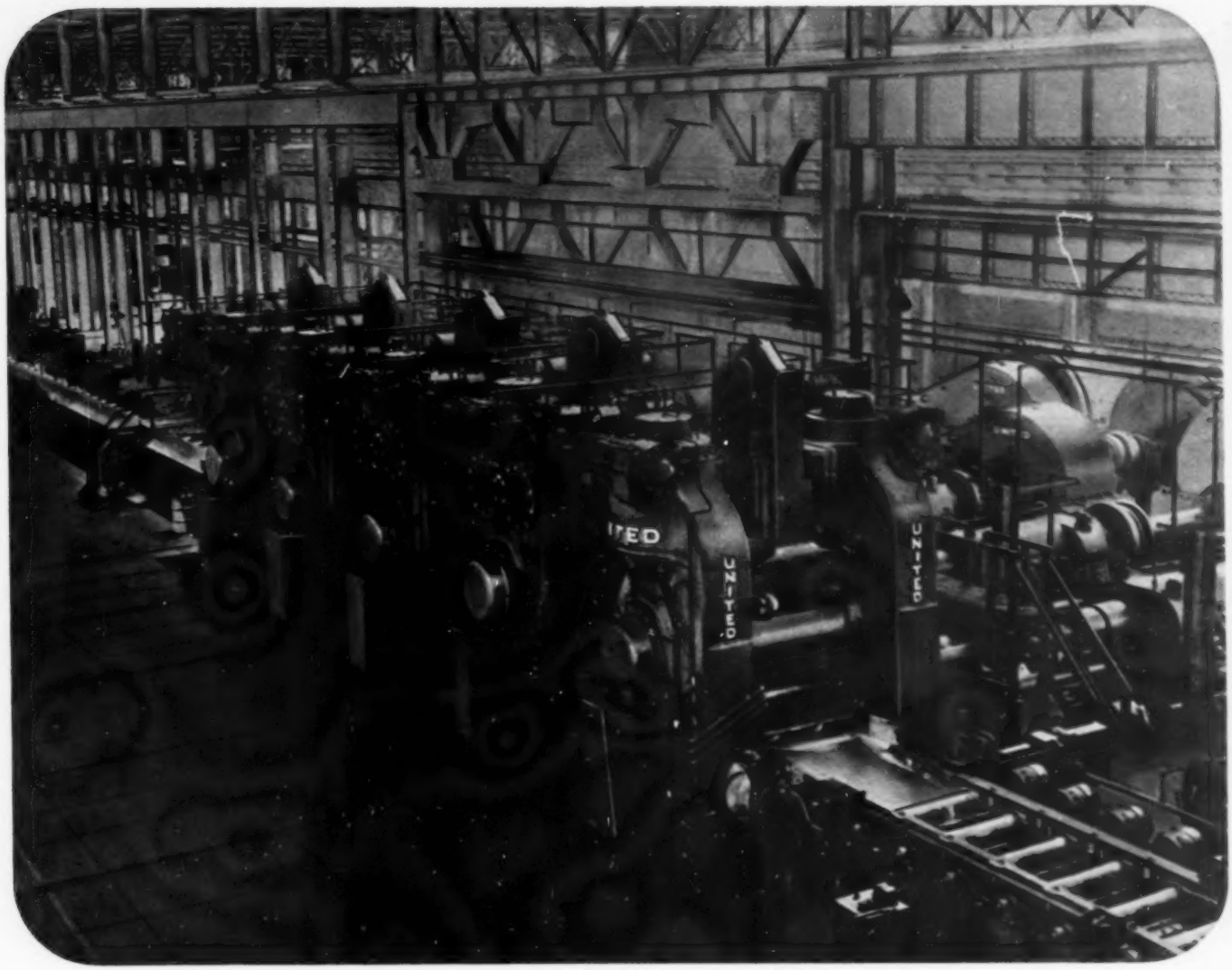
When your Plate Handling Cranes are "Shaw-Box," you utilize all the reliability, efficiency, and service that these cranes are known for throughout the steel industry. Plate Handling Cranes are a specialty with us, growing through years of study and field experience in designing and producing this type of equipment to fully meet the most severe and exacting mill service specifications.

Specialization in pioneering, designing, and producing Plate Handling Cranes has long been a "Shaw-Box" tradition. Working hand in glove with the steel industry, "Shaw-Box" research men and engineers have gained the intimate understanding of plate handling requirements that has developed features such as variable flux control — lifting magnets that discharge one plate at a time after picking up several — rope lifts instead of bars, with guides to restrict swing — and many other advantages for faster, dependable operation.

Even with these special features, engineering, construction, and design expense involved in building "Shaw-Box" Plate Handling Cranes is exceptionally low.

Be sure to send all your inquiries and specifications for Plate Handling Cranes and Gantries to "Shaw-Box."

MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
MUSKEGON, MICHIGAN



Rolling aluminum on Continuous Hot Mill Finishing Stands for use in the fabrication of aircraft, modern railway rolling stock, domestic appliances, etc.

Designed and built by

UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

PLANTS AT: PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN CANTON

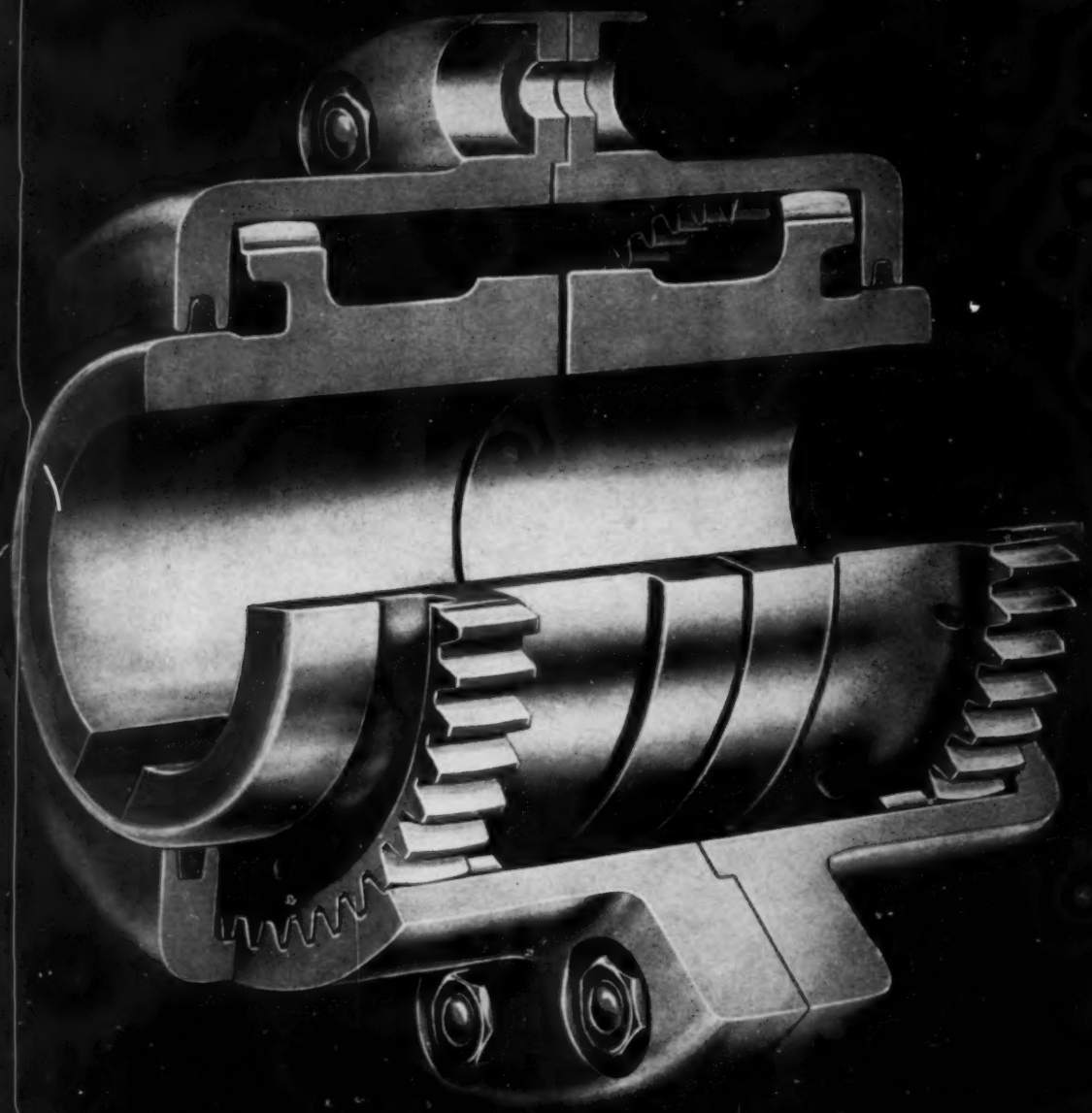
Subsidiary:
Adamson United Company, Akron, Ohio

Affiliates:
Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal P. Q. Canada
S. E. C. I. M., Paris, France

Designers and Makers of Rolls and Rolling Mill Equipment

REG. T.M.

POOLE



OPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

LE FOUNDRY & MACHINE COMPANY WOODBERRY, BALTIMORE, MD.

TAYCO-40

BETTER BEFORE . . . *BEST NOW*

TAYCO-40 high-temperature silica cement has been used and endorsed by superintendents of the majority of the leading steel mills in the United States to lengthen life of silica open-hearth furnace roofs. That fact alone is a convincing testimonial to the superior qualities of TAYCO-40 in the form it had been made.

Now the working and trowelling properties of TAYCO-40, always outstanding, have been improved.

- **TAYCO-40 now stays in suspension even longer than ever before — no tendency to form a jelly-like consistency with free water floating on top of the mortar box.**
- **The water retention properties have been materially improved.**

Improved TAYCO-40 is now being supplied on all orders. Have you tried it recently? Now, more than ever before, roofs bonded with TAYCO-40 last longer and, in the long run, are more economical. Less cement is used—thinner, tighter joints are obtained — losses in mixing and handling are reduced.

TAYCO-40 was better before
. . . it's the best now

Refractorers to industry since 1864.

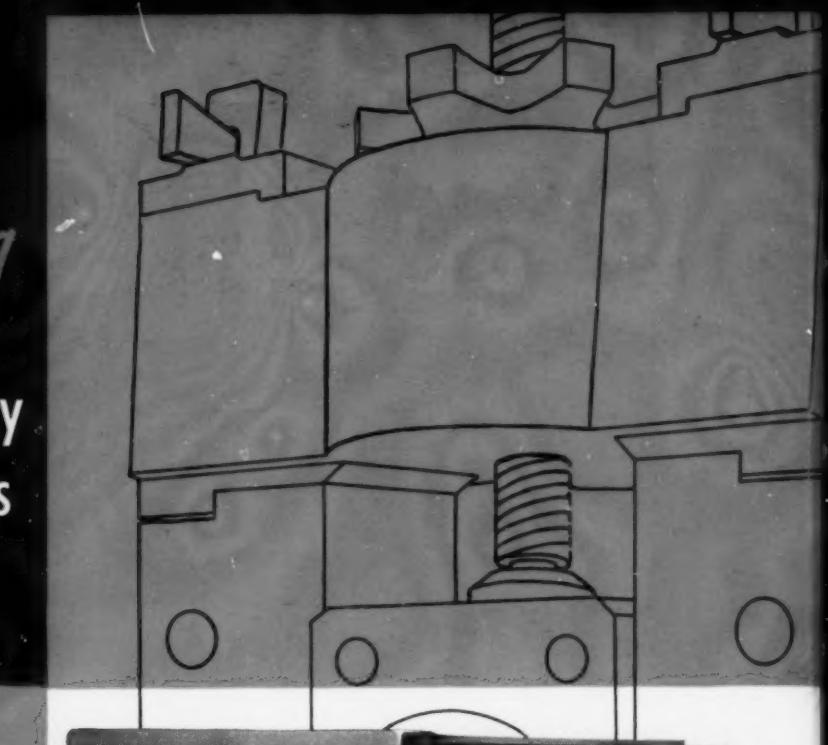
Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
Hamilton and Montreal

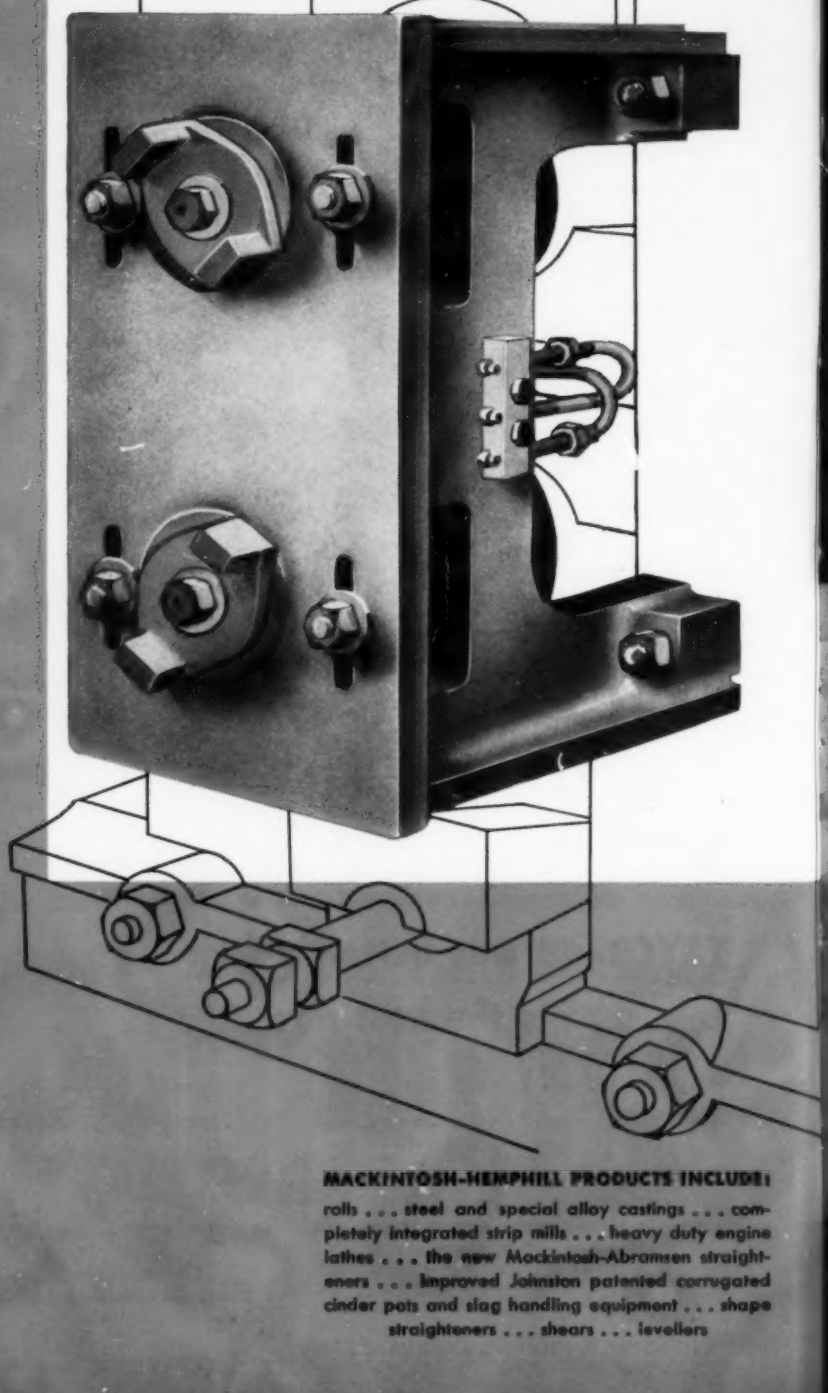
The CHAS. TAYLOR SONS Co.
REG. U. S. PAT. OFF.
MANUFACTURERS OF REFRACTORIES • CINCINNATI • OHIO • U. S. A.

Mack-Hemp

end-thrust bearing

Improves Operating Efficiency of Rod, Bar and Shape Mills





Not much for glamour, but a bear for work, this Mack-Hemp End-Thrust Bearing does an all-'round job of improving the operation of rod, bar and shape mills.

Developed by Mackintosh-Hemphill engineers to establish precise control over the axial matching of roll passes, this thrust bearing is a self-contained, compact unit which will team up with any type of good radial neck bearing, and which can be used on any mill stand where one end of the rolls is available for its attachment.

One of the most important features of the Mack-Hemp Bearing is the simple end-wise adjustment device which assures matched grooves and precise product tolerance on high-speed finishing stands.

Other advantages observed in exhaustive tests include:

- Elimination of conventional side thrust collars
- Permanence of roll groove alignment
- Increased life of roll grooves and guides
- Long life of anti-friction thrust bearings
- Reduced electrical loads in starting and running mill

Latest in the long list of products designed to improve metal-rolling techniques, this Mack-Hemp End-Thrust Bearing has passed every operating test. Full details are available—a qualified engineer is ready to show you why you should keep an eye on what's new at Mack-Hemp.

MACKINTOSH-HEMPHILL CO.

PITTSBURGH AND MIDLAND, PA.

Makers of the Rolls with the Striped Rod Wabblers

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE:
rolls . . . steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . the new Mackintosh-Abramsen straighteners . . . improved Johnston patented corrugated cinder pots and slag handling equipment . . . shape straighteners . . . shears . . . levellers

Alliance

FIRST IN SIZE
FIRST IN CRANE DESIGN

INDUSTRY WANTS SAFETY, YOU GET SAFETY WITH ALLIANCE CRANES

● Dependably safe! That's this 4-girder Alliance Ladle Crane. With a wide safety factor, it's engineered to operate 24 hours daily year after year with unbelievable minimum of maintenance. This powerful crane is equipped with an auxiliary trolley having a 60-ton and 20-ton hoist, safety rope reeving and synchronized worm drive, and a safety compartment containing a duplicate bridge master control. This lets the operator move the crane in safety in case hot metal is accidentally spilled. Another Alliance safety feature is the enclosed stairway leading from the cab to footwalk on the crane girder.

Known the world over, Alliance Cranes handle more hot metal than any other make. Alliance has constructed the largest cranes ever built considering height and capacity of lift.

Think now about giving your plant more lifting power by developing new cranes or reconverting old ones.

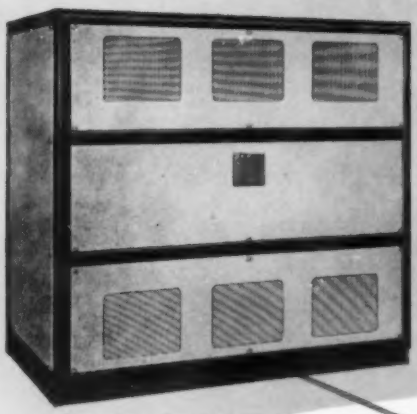
BIG
CRANES

THE ALLIANCE MACHINE COMPANY

MAIN OFFICE
ALLIANCE, OHIO

PITTSBURGH OFFICE
1622 OLIVER BUILDING, PITTSBURGH, PA.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

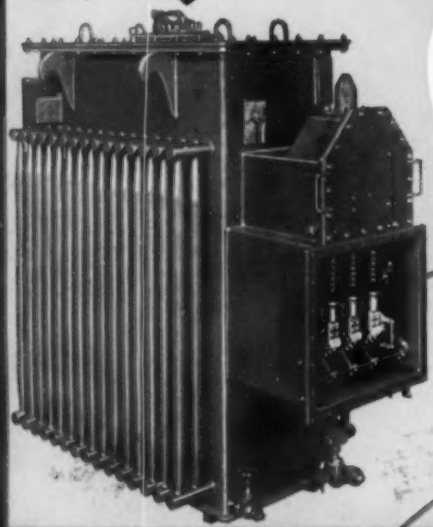


DRY TYPE
Natural and Forced Air Cooled

1000 KVA, 3 phase,
80°C. rise
Class B Insulation
4160Y—480 Δ volts

NETWORK
Submersible and Vault type

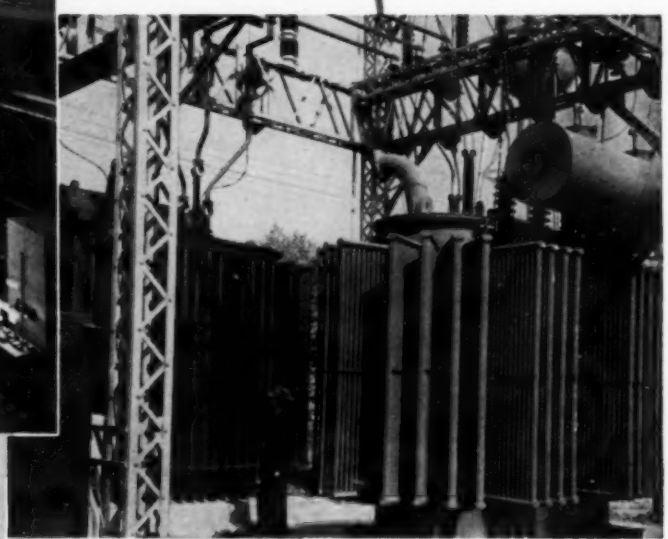
500 KVA,
3 phase,
60 cycles
7200/12,470Y-
208Y/120

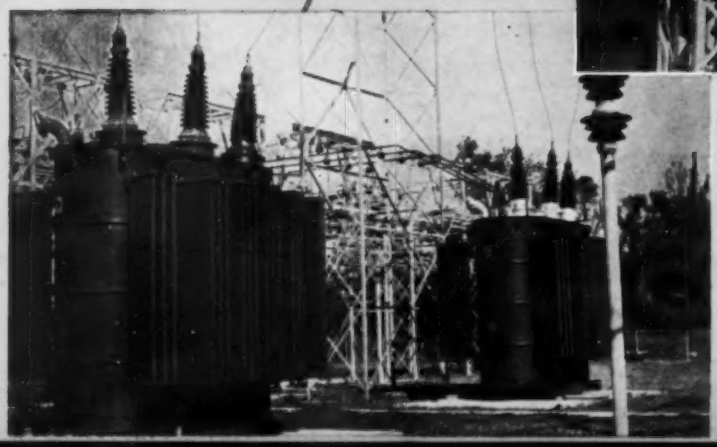


Pennsylvania TRANSFORMERS

The TRADE

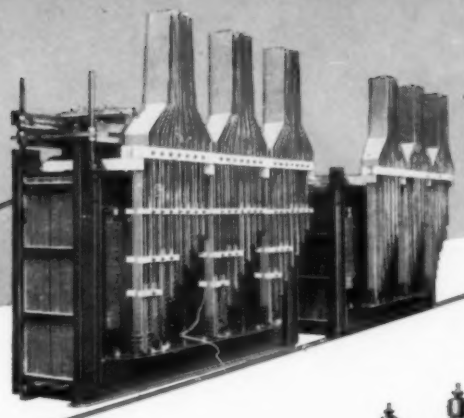
View of Main Assembly floor at Pennsylvania's modern plant in Canonsburg, Pennsylvania.





ONE 5000 KVA and ONE 7500 KVA, 3 phase, 60 cycles, OA. 33,000 Δ — 2400/4160Y volts.

TWO 7500 KVA Pennsylvania Transformers, 3 phase, 60 cycles, OA. 115,000Δ—13,800Y/8000 volts.

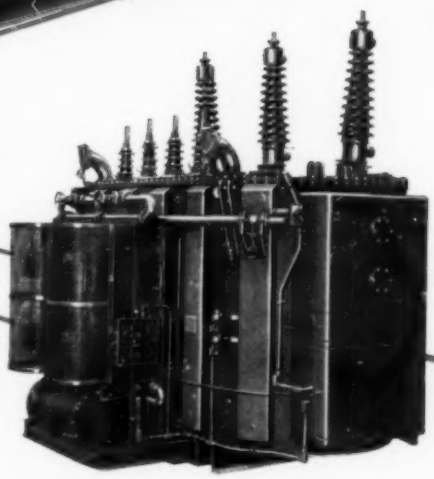


FURNACE
For operating Electric Arc Furnaces as large as 75 tons.

2—10,000 KVA, 3 phase, 60 cycles, OIWC.

POWER
667 KVA to 50,000 KVA
Up to 230,000 volts.

Detachable Radiators 15,000 KVA, 3 phase, 69,400Y— 13800 Δ volts



LARGE POWER
Forced Oil Cooled

30,000 KVA, 3 phase, 132,000— 25,000 volts

STANDARD PA POWER
Up to 10,000 KV
Up to 34.5 KV

3750 KVA, 3 pha OA, 12,000 Δ — 4160Y volts

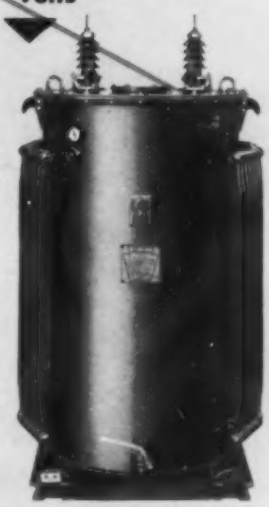
MARK that represents a distinguished product to the electrical world

Sound management, thorough knowledge of the product, and good workmanship is earning Pennsylvania Transformer Company an honored place in the Electrical World. Modern equipment and over ½ million square feet of efficiently arranged floor space enables Pennsylvania's 1100 men and women to concentrate on building good, reliable transformers. A special Planning Department, devoting all of its time to research and development work, promotes improvements such as those incorporated into Pennsylvania's Pole Star and Standard Parts Power Transformers.

TOMORROW, as TODAY, the Pennsylvania trade mark will continue to represent the finest in transformers.

DISTRIBUTION
3 KVA to 500 KVA
Up to 66,000 volts.

500 KVA, single phase, 60 cycles, OA 14,400—240x480 volts



The POLE STAR

100 KVA and below 14,400 volts and bel conforming to E.E.I.-NEMA Standards

Pennsylvania
TRANSFORMER COMPANY
CANONSBURG, PENNSYLVANIA
Greater Pittsburgh District

We invite you to write for Pole Star Catalogs No. 349 and 1049. Also ask for Pennsylvania Standard Parts Power Transformer Booklet No. 1492.

Pennsylvania's complete line of transformers includes: Askarel Transformers, Unit Substation Transformers, Portable Unit Substation Transformers, and Pipe Welding Transformers.

BONNOT INSPECTION TABLE

PROVEN KEY TO

Greater Steel Production AT LOWER COST PER TON

Whether you have *billets or bars—rods or rails—small slabs or tubes* for inspection in your mill, a Bonnot Inspection Table will give you greater production . . . at lower cost per ton.

Used for any general inspection, or in conjunction with the Bonnot Billeteer, the Hydraulic Inspection Table is another pioneering development (proven in service) of Bonnot engineers that offers these major advantages:

SY! Inspection and marking flaws in et—one side; with Bonnot Hydraulic pection Table, operator works easily, ciently, safely.

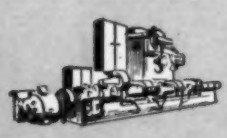
ST! Inspection and marking flaws—2 s and corner at the same time, and hin reach of operator without his chang- position.

ONOMICAL! Discharging billet for- d after marking. Note unmarked billet lower right) awaiting placement for actically continuous" inspection.

1. assures faster, better inspection because inspector sees 2 faces at one time; he completes all operations from just one position, and with easy wrist motion.
2. enables inspector to work without interfering with Billeteer operator or other billet-cleaning workers and vice versa.
3. increases production because one Inspection Table can keep as many as 6 Billeteers operating at capacity.
4. segregates sizes of raw material so it can be "worked" in practical sequence; production up 15% or more.
5. available for other inspection work involving the quick, accurate and effective handling of heavy material.
6. saves machine time because inspection and marking are done in advance.
7. eliminates need of putting all material through machine; normal practice when pre-machine inspection is not provided.
8. eliminates dangerous, time-consuming hard work of floor inspection.
9. reduces accident hazards, frees storage space for other uses because material is handled more efficiently.
10. speeds "conditioning" by "sorting" material according to work —(a) surfaced completely, (b) flaws or spotting, (c) rejects, (d) no machining.

BONNOT WILL "ENGINEER" AN INSPECTION TABLE TO YOUR EXACT NEEDS. WRITE TODAY!

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER

ALSO MANUFACTURERS OF

SAWING · CRUSHING · PULVERIZING & MIXING EQUIPMENT · BILLET INSPECTION TABLES · DUST PUG MILLS · SINTER PLANT PUG MILLS

Just off the press!

A new arc welding machine catalog—
Welders for AC, DC, gas engine operation
—capacities of 100 to 500 amperes.

Here, at last, is a helpful booklet that gives you complete data on all Airco arc welders — the machines with the stinger that penetrates. Divided into easy-to-read sections, you can quickly determine the welder suited to your production or maintenance job.

This booklet is handy, useful, bringing you a wealth of information covering design, distinctive features, specifications, power requirements, electrical characteristics, and outstanding operational qualities of each welder in the entire Airco line.

To give you some idea of the amount of material covered by this definitive booklet, here are a few of the many welders covered.

- "Bumblebee" and MCT — Transformer AC Arc Welding Machines
- "Hornet" 36A and "Wasp" — DC Arc Welding Machines
- "Yellow Jacket" Gas-Engine Driven Arc Welders
- Customer-Assembled Gas Engine Sets

See this booklet yourself . . . send for it today. Just fill in the coupon below for your free copy.

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Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Cutting Machines
Gas Welding Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

Send for this FREE catalog today!

Air Reduction Sales Company
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Please send me a copy of your NEW Arc Welding Machine Catalog No. 8.

Name_____

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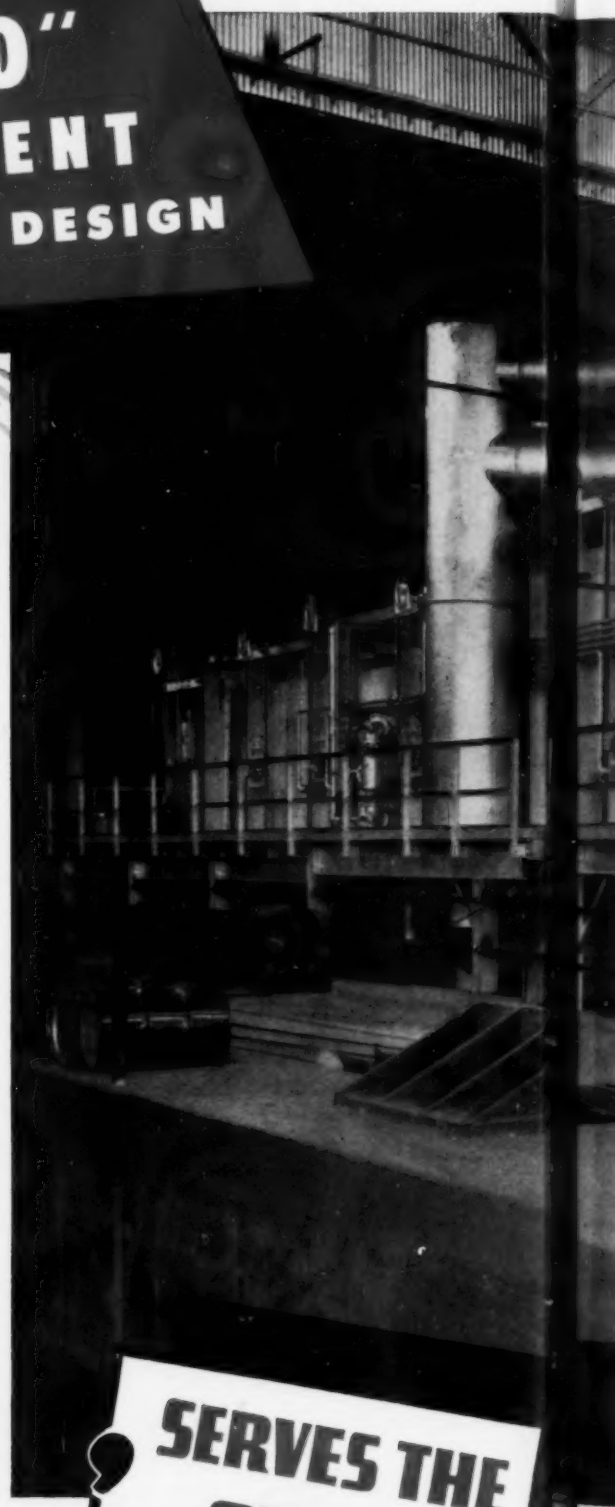
'Surface' RECUPERATIVE TYPE

WITH "TRIPLE-FIRED" BURNER ARRANGEMENT OF SURFACE COMBUSTION DESIGN



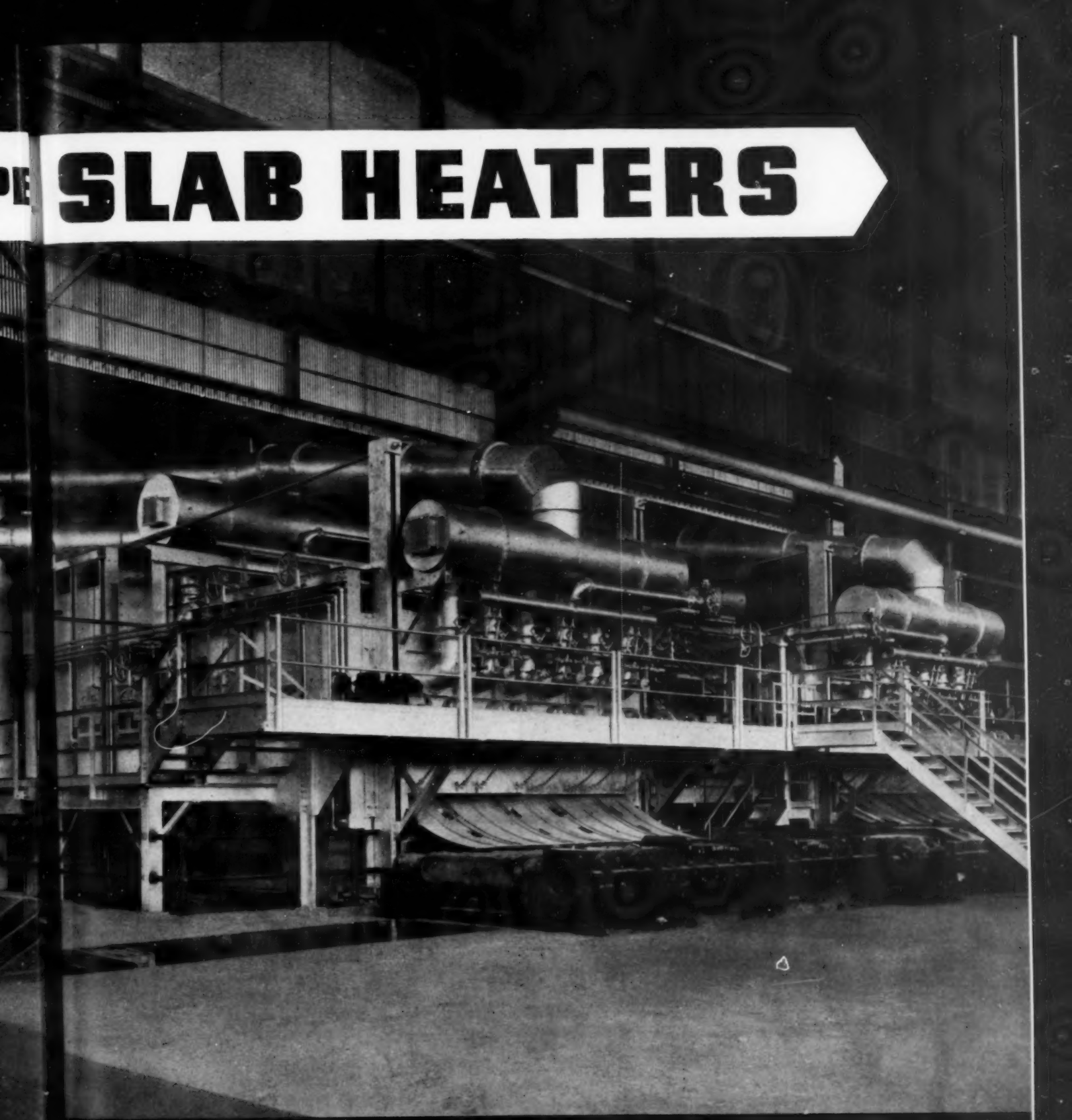
'Surface' Slab Heaters range in size up to the largest individual unit in the world, having an effective hearth size of 91 ft. by 28 ft.

These units are of the pusher type and have a solid soaking hearth. The water cooled skids in the main heating section are insulated by a patented method, contributing to fuel saving and reduction in the amount of cooling water required. All common fuels can be used. They feature recuperators and automatic temperature, combustion and draft controls.

'Surface' engineers will welcome the opportunity of working with you on heating and heat treating equipment needs.

'Surface'

SERVES THE STEEL INDUSTRY



SLAB HEATERS

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

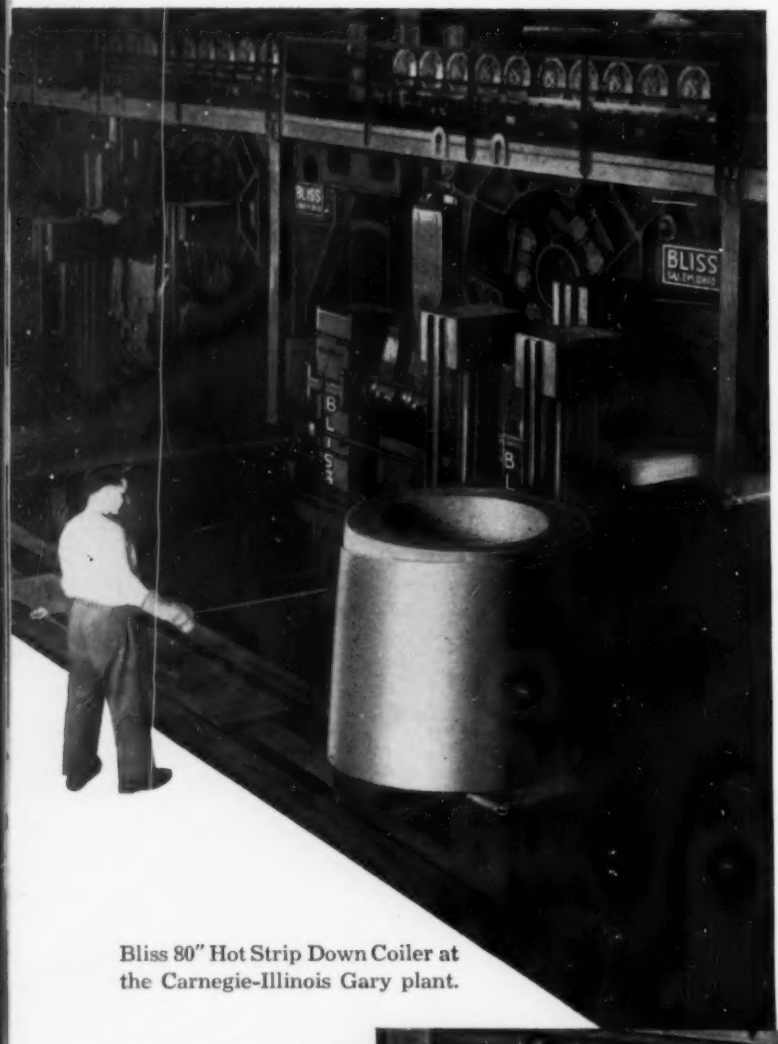
FOREIGN AFFILIATE COMPANIES

BRITISH FURNACES LIMITED—CHESTERFIELD
STEIN & ATKINSON, LTD.—LONDON

STEIN & ROUBAIX—PARIS, LIEGE AND GENOA
WILL L. SMITH, S.A.—BUENOS AIRES

- One-Way Fired Soaking Pits
- Billet Reheating Furnaces
- Slab Heating Furnaces
- Continuous Type, Controlled Atmosphere Strip Annealing and Normalizing Furnaces
- Controlled Atmosphere Annealing Covers for Wire and Rod
- Controlled Atmosphere Annealing Covers for Coil and Sheets
- Continuous Furnaces for Heat Treatment of Steel Plate
- Controlled Atmosphere Furnaces for Carbon Correction in High Alloy Rod and Bar Stock
- Continuous Type Bright Annealing and Normalizing Furnaces
- Prepared Gas Atmosphere Generating Equipment
- Pit Type Convection Furnaces for Rod Annealing
- Stress Relief Furnaces
- Wire Patenting Furnaces

Another Bliss Original



Bliss 80" Hot Strip Down Coiler at the Carnegie-Illinois Gary plant.

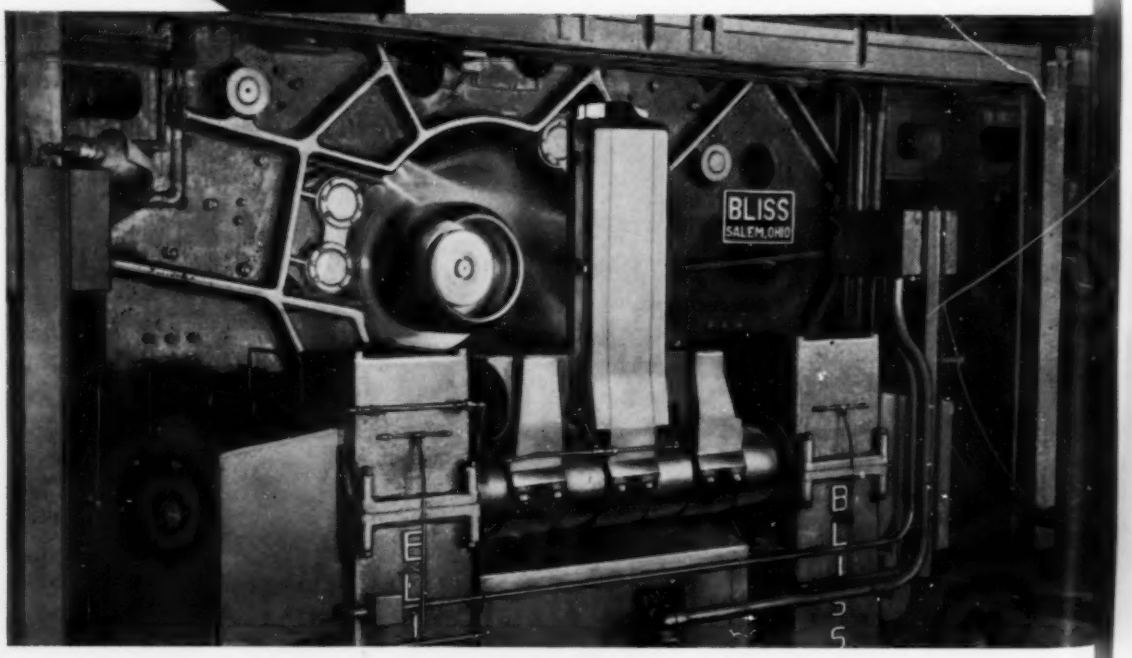
Tightly wound, smooth-edged coils that make for easy stacking and handling, quick ejection of finished coils, fast winding speed, extreme versatility as to gage and coil width, easy maintenance and minimum blocker roll wear—those are results this 80" Hot Strip Down Coiler gives. Engineered and built by Bliss for the Carnegie-Illinois Steel Corporation, it's the first design to use an expanding mandrel, which makes possible *all* these results.

There were engineers who said it couldn't be done for hot strip, but Bliss succeeded where others would not try.

Hot or cold rolling of ferrous or non-ferrous metals...2-, 3-, 4-high, or cluster mills ...Bliss builds them all to meet your requirements. For keen engineering counsel on rolling mills, as on presses, put your problem up to Bliss.

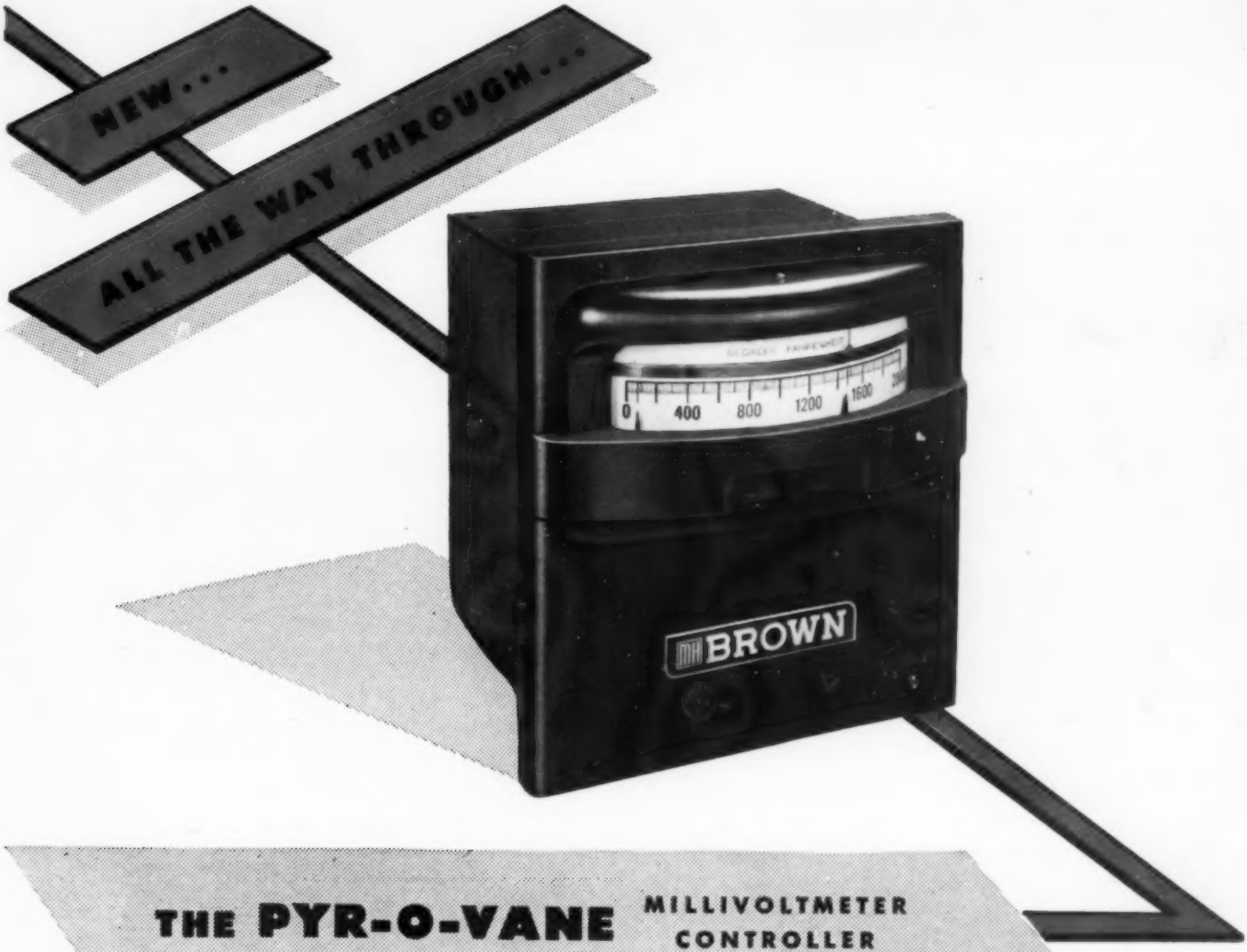
E. W. Bliss Company
General Office: Toledo 7, Ohio
Rolling Mill Division
Salem, Ohio

Action photograph of coiler producing a coil.



MARQUETTE · BLISS · CONSOLIDATED · TOLEDO ·
BLISS BUILT

ROLLING MILLS · PRESSES · CONTAINER MACHINERY



THE PYR-O-VANE MILLIVOLTMETER CONTROLLER

REPORTS of high praise are coming in from the field for this latest addition to the Brown line of versatile temperature controllers . . . the millivoltmeter controller based on the quick-as-a-flash electronic principle.

Its outstanding features will help set new standards of performance in metal producing, wherever precision and accuracy are processing musts. Here are the more important reasons:

- *Corrective action is instantaneous . . . provides* continuous non-cyclic control.
- *Separately enclosed high-resistance galvanometer, more sensitive and powerful, reduces maintenance.*
- *Electronic control unit plugs in . . . is highly immune to ambient temperature and humidity changes.*
- *"Fail-safe" design and thermocouple burn-out feature protect work load.*
- *Case is universal . . . for flush or surface mounting.*

COMMERCIAL • RESIDENTIAL • INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

Your local Honeywell engineer is ready to give you more detailed information . . . and he is as near as your phone. Call him in today, or write for a copy of Specification Sheet 112.

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4454 Wayne Ave., Philadelphia 44, Pa.
Offices in 77 principal cities of the United States, Canada and throughout the world

Minneapolis Honeywell — *Advanced Instrumentation* FOR METAL PRODUCING — BROWN INSTRUMENTS

In 1924, Okolite insulation was first used by utilities and industrial plants. Since then, Okolite insulated cables have delivered outstanding performance consistently in a wide variety of exacting services.

24 YEARS OF SERVICE PROVE . . . .

Hundreds of miles of Okolite-insulated cables used in high voltage service include insulated power cables operating at voltages as high as 35,000 between phases.

HIGH VOLTAGE APPLICATIONS PROVE . . . .

In addition to high voltage a-c proof tests made as a matter of routine, Okolite-insulated cables pass d-c proof tests also—tests made at 4 times the a-c values.

SUPER VOLTAGE D-C TESTS PROVE . . . .

OKOLITE INSULATION gives the internal stability all Long-Lived cables need

No single part of a cable affects its life more certainly than does its insulation. No matter how a cable is outwardly protected, trouble can develop internally if the insulating medium loses stability, deteriorates in electrical values, absorbs moisture.

Not only does Okolite possess stable electrical characteristics plus moisture and ozone resistance but its heat resistance has been firmly established at 75 degrees C. conductor temperature under all kinds of service conditions.

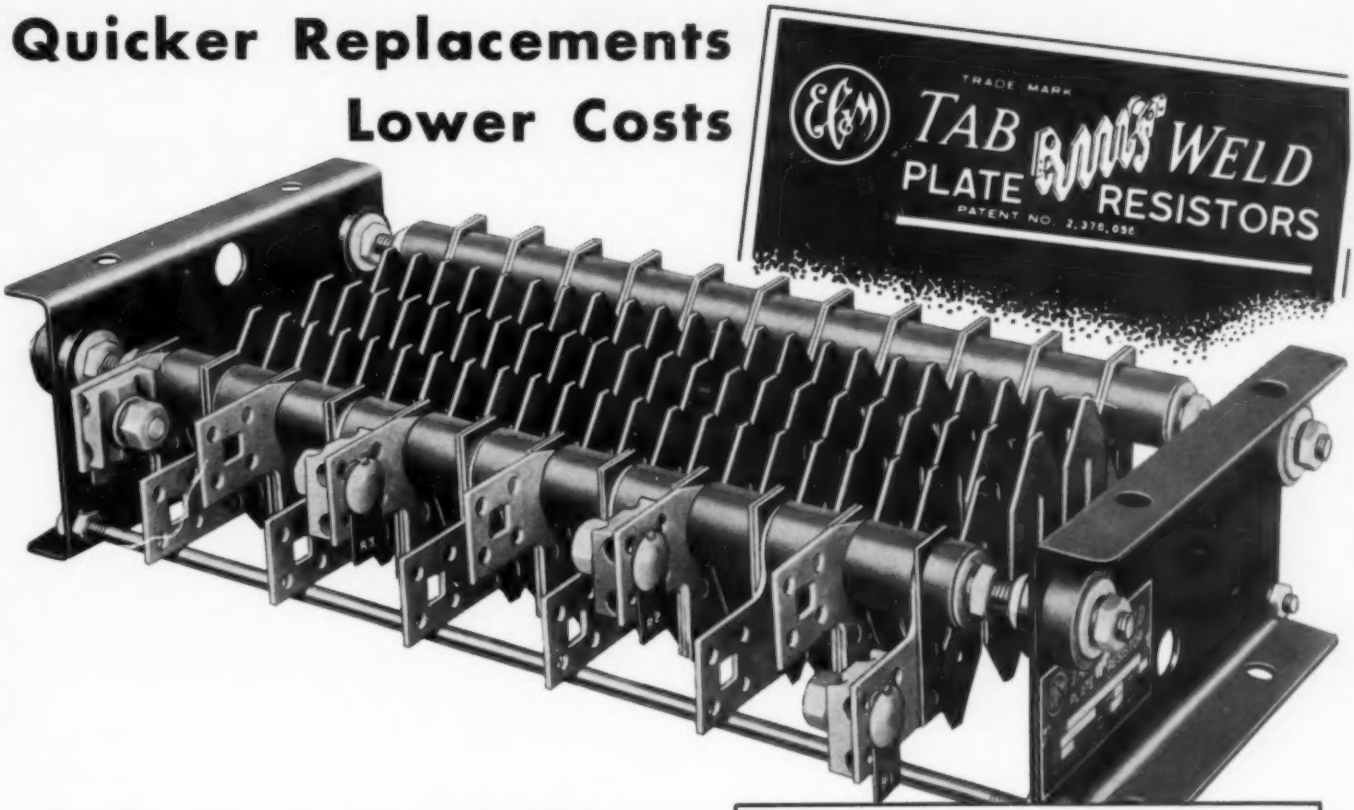
Okonite's patented strip insulating method insures uniform wall thickness — an essential in high voltage cables. For details including Okolite advantages over lead-covered as well as ordinary rubber-insulated cables, write for Bulletin IS - 1035 addressing The Okonite Company, Passaic, New Jersey.

7072

OKONITE insulated wires and cables

THE BEST CABLE IS YOUR BEST POLICY

Quicker Replacements Lower Costs



These Standard ASSEMBLIES Simplify the REPLACEMENT-PROGRAM

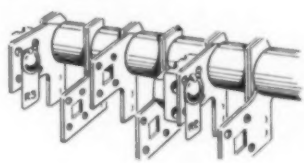
EC&M *Tab-Weld* Resistor sections for d-c crane and mill control have uniform mounting dimensions for *all* sections. Internally, each section has all grids of the same size, with grids connected in series.

Sections are rated with continuous current carrying capacities from 32 to 150 amperes, depending upon the size of grid per section. These mill sections, using nine different sizes of grids, require *no change — no shop alteration* when a field replacement is needed.

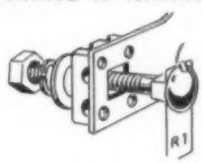
Convenient taps, resistance value stabilized by welding, shorten the replacement time. *Switch to EC&M Bulletin 942 Tab-Weld Plate Resistors.*

Each section complete with—

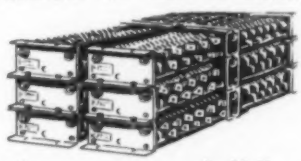
1—Suitable taps permanently in place at convenient points.



2—Terminal blocks with metal identification tag affixed to terminal bolts.



3—Uniform end - frame mounting hole dimensions for ease of stacking.

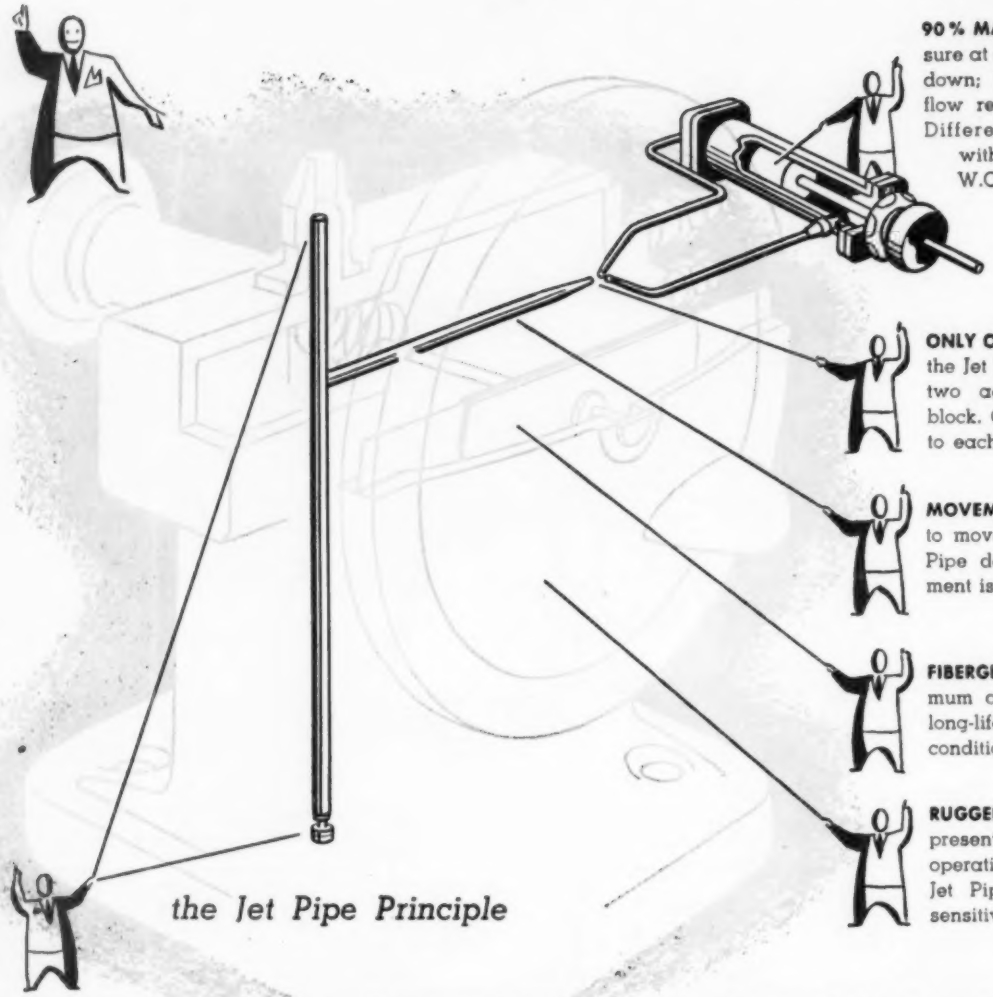


Use from storeroom shelf "as is."

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

Here's Why You'll Like

Askania Controls



the Jet Pipe Principle

90% MAXIMUM RECOVERY of inlet pressure at operating cylinder; 10 to 1 turndown; 1% accuracy over range; (i.e., flow regulator designed for 3" W.C. Differential Pressure would control within an accuracy of ±.03" W.C.).

ONLY ONE MOVING PART in the relay—the Jet Pipe—which discharges oil into two adjacent orifices in distributor block. One of the orifices is connected to each side of piston.

MOVEMENT OF JET PIPE causes piston to move at a rate proportional to Jet Pipe deflection. Total Jet Pipe movement is less than one degree.

FIBERGLAS DIAPHRAGM presents maximum of sensitivity with maximum of long-life, detects changes of operating conditions as small as .0025" W.C.

RUGGED CONSTRUCTION of regulator presents best possible protection for operation of single moving part—the Jet Pipe, combining sturdiness with sensitivity and accuracy.

JET PIPE needs support at only two points, upper and lower bearings, by fitted connections always bathed in oil to provide constant lubrication and prevent friction (oil flow enters Jet Pipe at top inlet bearing).

THESE SIX POINTS add up to why you'll like Askania Controls. Accuracy, sensitivity, stability, simplicity, ruggedness, maintenance-free operation: all points you can be sure of when you specify Askania Control. The reason for this is the Jet Pipe, heart of all Askania Regulators, a simple, accurate relay with only one moving part. By the Jet Pipe Principle, minute pressures or signals from the source of measurement are amplified into a powerful force.

For tough control jobs . . . for applications where dependability is all important . . . for processes requiring extreme accuracy, Askania Jet Pipe Controls are the ideal answer.

Ask for Bulletin 139J

ASKANIA Controls

ASKANIA REGULATOR COMPANY

A Subsidiary of General Precision Equipment Corporation

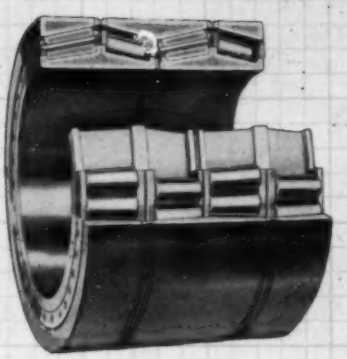
240 East Ontario Street, Chicago 11, Illinois

TORRINGTON ROLL NECK BEARINGS

for greater

rigidity

in Jones & Laughlin mill



Jones & Laughlin Steel Corporation's mile-a-minute cold strip mill (world's fastest) at Aliquippa incorporates the most advanced engineering experience.

A factor contributing to the mill's great rigidity—vital in securing rapid and accurate reduction of steel strip—is the use of Torrington Tapered Roll Neck Bearings specially engineered for use on work rolls.

These bearings accommodate larger roll neck diameters owing to their reduced cross-section, yet provide extra capacity to handle tremendous thrust and radial loads. High quality production and important operating economies are assured by this Torrington Roll Neck Bearing feature. For anti-friction bearings specially engineered to the design and service requirements of your application, call on Torrington.

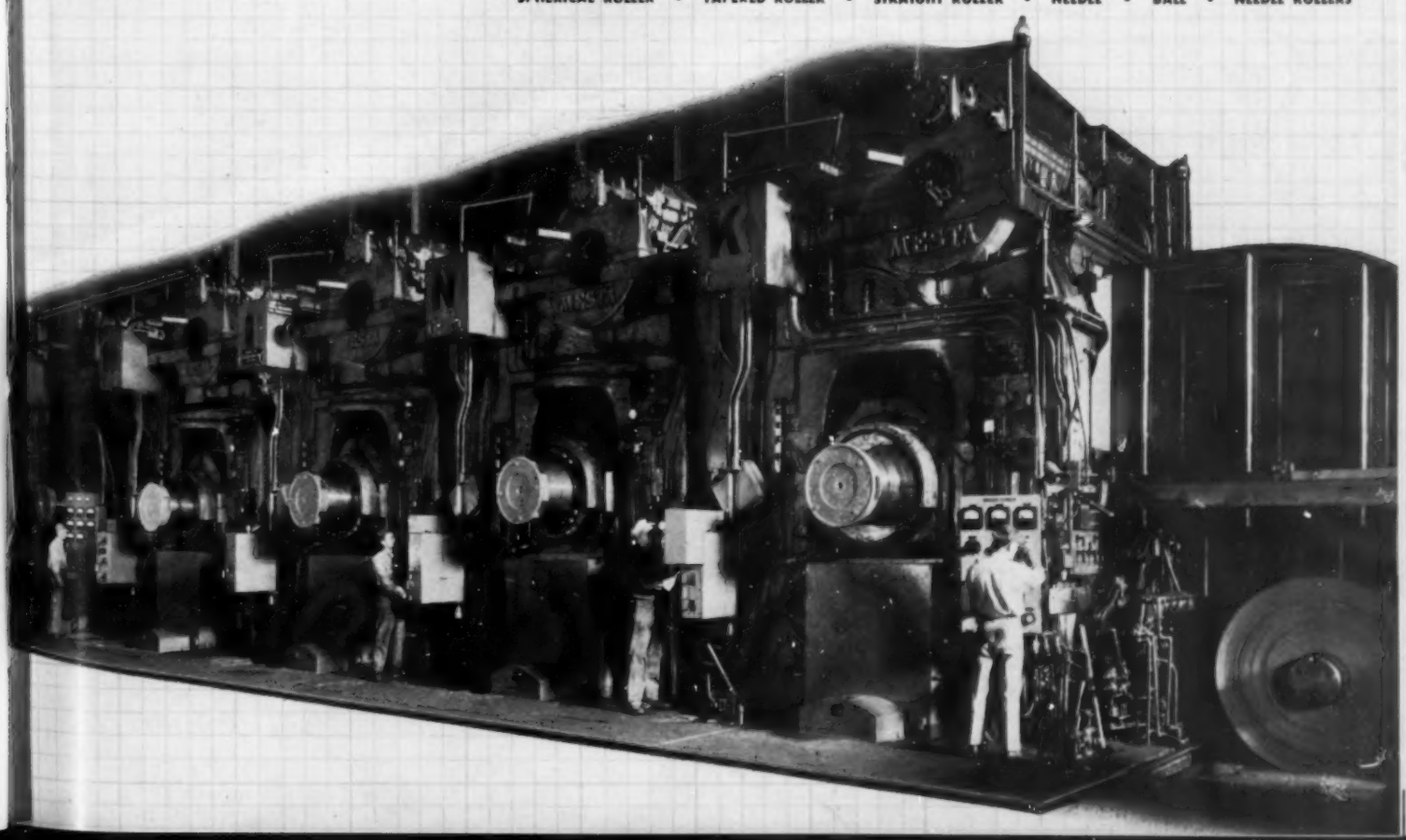
THE TORRINGTON COMPANY

South Bend 21, Ind. Torrington, Conn.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON *TAPERED ROLLER* **BEARINGS**

SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • NEEDLE • BALL • NEEDLE ROLLERS

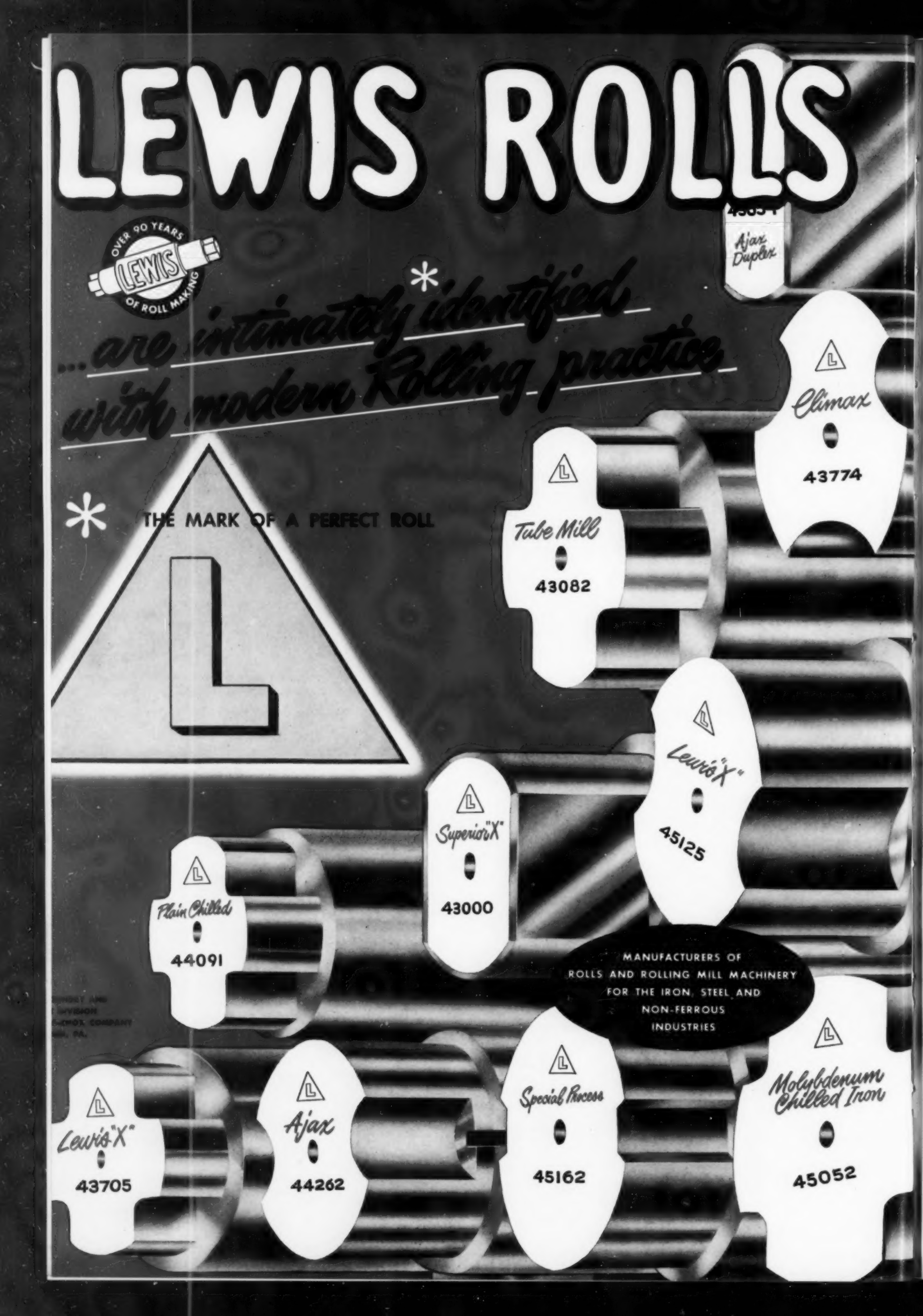


LEWIS ROLLS

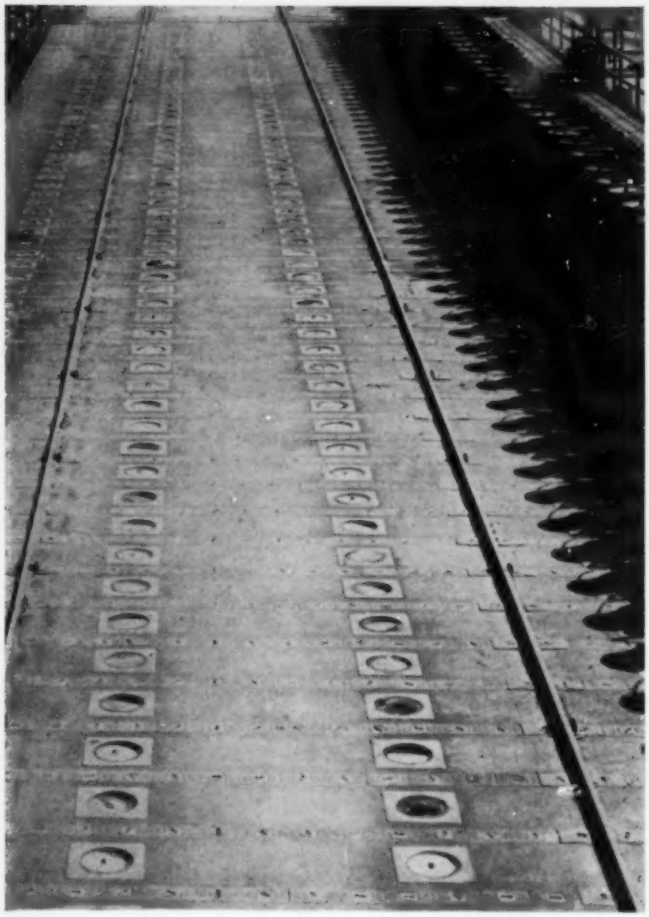
OVER 90 YEARS LEWIS OF ROLL MAKING

...are intimately identified* with modern Rolling practice

* THE MARK OF A PERFECT ROLL



Here's more proof that Lumnite* Concrete is the ADAPTABLE Refractory!



Paving for coke oven battery, Clairton By-product Coke Works, Carnegie-Illinois Steel Corp., Clairton, Pa. Lumnite Refractory Concrete withstands changing temperatures, resists corrosion and its one-piece, monolithic construction remains smooth, outlasting other paving materials.

Here's Where Lumnite Refractory Concrete Cuts Costs, Saves Time in Coke Plants

Coke plant operators, like many others, are finding more and more time- and money-saving uses for adaptable Lumnite Refractory Concrete. No other refractory material combines Lumnite's refractory properties with such convenience and flexibility of use. Refractory concrete is easily placed in any size, shape or form without skilled workmen. The large number of successful Lumnite installations now in use offers adequate proof of their excellent service records.

WHERE USED: Lumnite Refractory Concrete may be cast in place in coke plants for such uses as: coke oven paving, base pads and flues that last longer, yet cost less to construct and maintain. Refractory Concrete is also useful for many other installations subject to heat, corrosion and severe thermal shock such as backwalls for quenching cars. And, in addition, Lumnite is excellent for precast special shapes—door linings, baffles, blocks for inspection and charging holes, lintels, arches, arch slabs, riser pipe linings and seat blocks, gas gun blocks, caps for top of coke oven, and plugs to fit special openings.

SAVES TIME, CUTS COSTS: Refractory Concrete made with Lumnite calcium-aluminate cement and selected aggregates may be cast in place in exact sizes, shapes and thicknesses desired. Monolithic construction gives maximum durability, reduces outage time for repairs. When repairs are needed, they may be made quickly and easily overnight, because Lumnite reaches service strength in 24 hours or less. Always keep a supply of Lumnite cement on hand. Whether your plant calls for coke ovens or not, you may profit from the properties of time- and cost-saving Lumnite. Write today for further information to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, New York.

Base-slab and waste heat flue of heat-resistant concrete made with Lumnite. Withstands heat, and waste gases of burning coke. National Tube Co., Lorain, Ohio.

Coke side of Refractory Concrete door lining in service over ten years when this photo was taken. That's durability! Laclede Gas Light Co., St. Louis, Mo.

SPECIFY CASTABLE REFRACTORIES MADE WITH LUMNITE

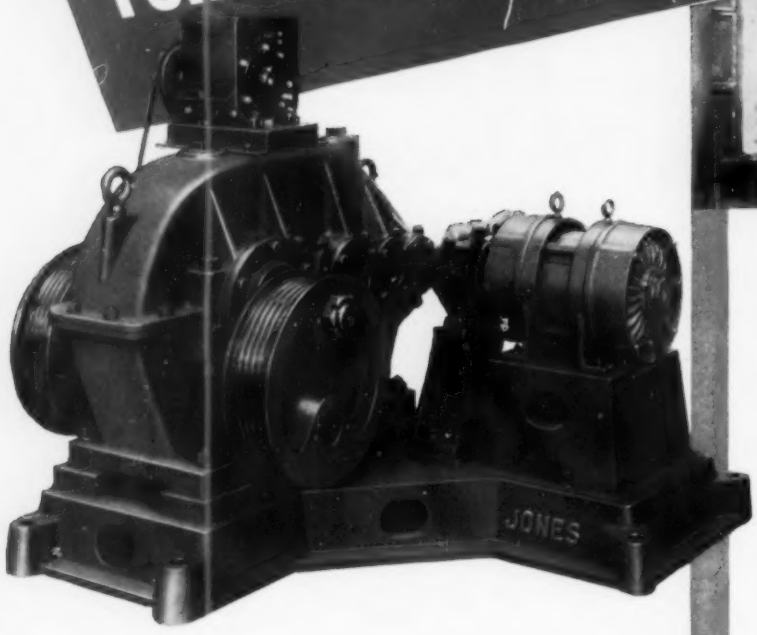
**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

18-L-27

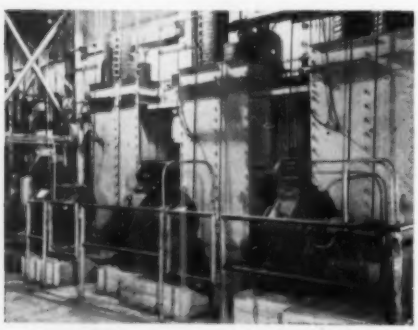
LUMNITE® A UNIVERSAL ATLAS PRODUCT **FOR REFRACTORY CONCRETE**

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

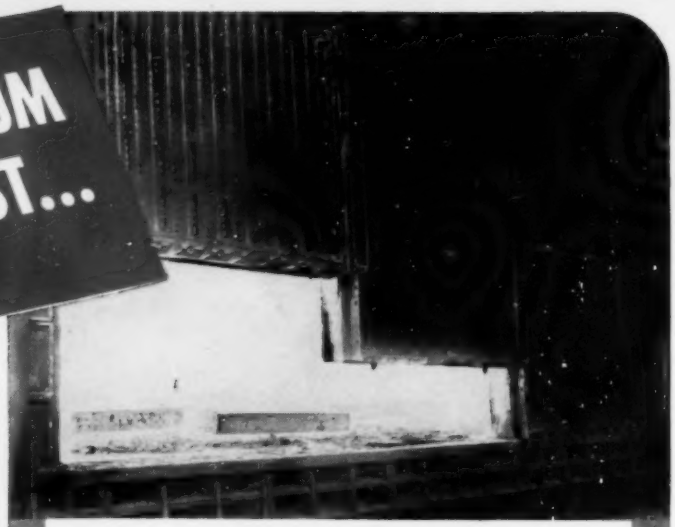
JONES ECCENTRIC DRUM FURNACE DOOR HOIST...



JONES ECCENTRIC DRUM FURNACE DOOR HOIST showing the two eccentric winding drums mounted on opposite ends of the slow speed shaft. Opening and closing take place on the short radius of the eccentric so minimum motor torque is required for starting. Furthermore there is practically zero impact when the door starts to open and when finally closing, as a protection to the refractory material. Electric brake is located between the motor and hoist and the limit switch is located on top of hoist. Speed reduction is through the Jones triple herringbone reducer unit.



Rear view of the furnace showing three of the six Jones eccentric drum type furnace hoists and the door counter weights.



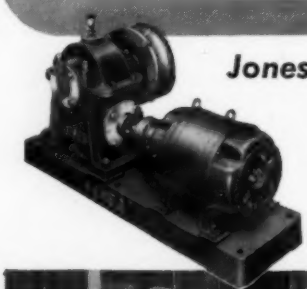
THE JONES ECCENTRIC DRUM FURNACE DOOR HOIST shown was developed when it was found necessary to eliminate all interior door jambs on the **AMSLER MORTON CORPORATION** recuperative plate mill furnace. The large plate mill ingots required wide doors and **FRAZIER-SIMPLEX, INC.** "Tilt-Lift" all-door furnace front walls were selected for this purpose. Since each furnace, of the installation illustrated here, has six consecutive doors and no front wall and each door weighs 8500 lbs. (counter weighted about 6600 lbs.), it can easily be appreciated that the door hoist came in for the most careful engineering study. Three consecutive doors on each side of the divided furnace provide an opening 21 ft. long in each furnace.

THE JONES ECCENTRIC DRUM TYPE HOISTS, developed to solve this door opening problem, have now been in operation several years and have provided the excellent service that has come to be taken for granted by the users of Jones transmission products.

Door hoists of this, and other types, are built by Jones as complete units with motor included, if desired, or with a base to take standard motor as supplied by purchaser.

If you have a door handling problem, the Jones engineering department will be pleased to make a recommendation covering a unit for it.

W. A. JONES FOUNDRY & MACHINE CO.
4431 Roosevelt Rd., Chicago 24, Ill.



Jones "Slipper type" Hoists for small furnace or mill building doors.

This Jones door hoist is built in several ratings and in almost any convenient arrangement of sheaves and cables. No limit switches of any kind are required with this unit. A bronze ring on the winding drum slips to take care of overwinding.

The two Jones door hoists shown at the left are installed for opening and closing mill building doors.

Since 1890

Jones

In the Service of Industry

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS
PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

Discover WHY Steel Mill Owners and Builders Call BRANDT

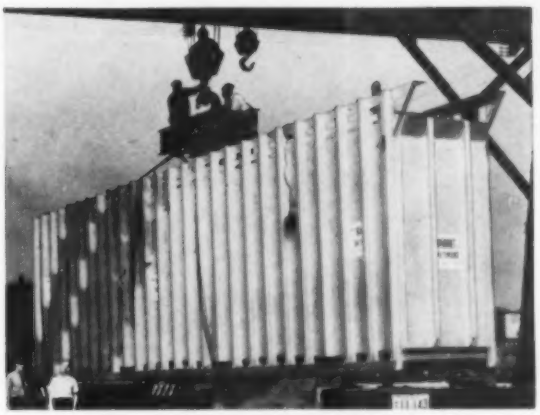
FOR FABRICATED COMPONENTS

such as:

ELECTROLYTIC PLATING TANKS
PICKLING TANKS
Plain or Rubber Lined
Completely Assembled
ROLLING MILL TABLES
HEAVY WELDMENTS
SPECIALIZED EQUIPMENT

BRANDT offers 240,000 sq ft of facilities for *real help* in solving your engineering and production problems. Help that *saves time* and *money too!* Completely equipped for fabricating *any type* of metal. Precision metal craftsmen since 1890, accustomed to handling a variety of *specialized projects* in a wide range of sizes.

STEEL CONTROL AND REGISTER HOUSE FOR STEEL MILL



30 TON ELECTROLYTIC PLATING TANK BUILT FOR A STEEL MILL CUSTOMER

STEEL MILL ROLL TABLES

BRANDT BALTIMORE *measures up!*

TO STEEL MILL EQUIPMENT SPECIFICATIONS

(Reference file of Specialized Facilities (No. 509) sent on request)

Brandt facilities are all under one roof, strategically located near steel mills, in the midst of major rail, water and highway transportation systems.

CHARLES T. BRANDT, INC. 1700 RIDGELY ST. BALTIMORE 30, MD.

This **HOMESTEAD VALVE** opens or closes instantly . . . every time . . . any time

IT'S STICK-PROOF

BECAUSE IT'S LEVER-SEALD

HOMESTEAD LEVER-SEALD QUARTER-TURN VALVES have been first choice for more than 16 years in services where extremes of temperature or pressure, or corrosive fluids, cause ordinary valves to "stick" or "seize".

They are "stick-proof" because built into each valve is a powerful lever-and-screw device that prevents sticking and assures positive action at all times under all conditions.

They operate faster too, than screw-stem type valves . . . 16 to 28 times faster. And the quarter-turn principle makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where other types of valves could not be used. Next time you have a sticking or damaged valve replace it with a Homestead LEVER-SEALD Quarter-Turn Valve. You'll never be satisfied with ordinary valves again.

Homestead Lever-Seald Quarter-Turn Valves are available in metals and alloys to suit your needs in sizes from $1\frac{1}{2}$" to 10" for pressures from vacuum to 1500 lbs.

- **Instant Stick-Proof Operation.**
- **Quarter-turn fully opens or closes.**
- **Seating surfaces always protected. Corrosion practically eliminated.**
- **Unobstructed straight-line fluid flow.**
- **All moving parts protected from effects of service conditions and weather.**

For full particulars send for "Valve Reference Book No. 39-3." Write today.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1802"

P. O. BOX 21 **CORAOPOLIS, PA.**

PRODUCTION IS UP!

COSTS ARE DOWN!

WITH P&H ELECTRIC SHOVELS . . .

. . . at the Steep Rock Iron Mines in Canada. Here, the first P&H Model 1400 (4 cu. yds.) was quickly followed by two more.

Bigger tonnage at lower cost . . . that's the real test. And there's where you'll find the P&H 1400 leads the way with such features as the Magnetorque* which electro-magnetically powers the hoisting motions . . . *smoother, faster,* and more *dependably.* Quicker move-ups by independent propel add *more* tonnage. Stepless electrical control saves time by eliminating *all* contactor troubles. These and many other P&H features combine to give you increased production. Greater production means greater profits for you. Write, today, for information.

*Trade-mark of Harnischfeger Corporation for electro-magnetic type clutch.

Every third P&H electric shovel sold is a repeat order.

P&H ELECTRIC SHOVELS
4455 West National Avenue
Milwaukee 14, Wisconsin

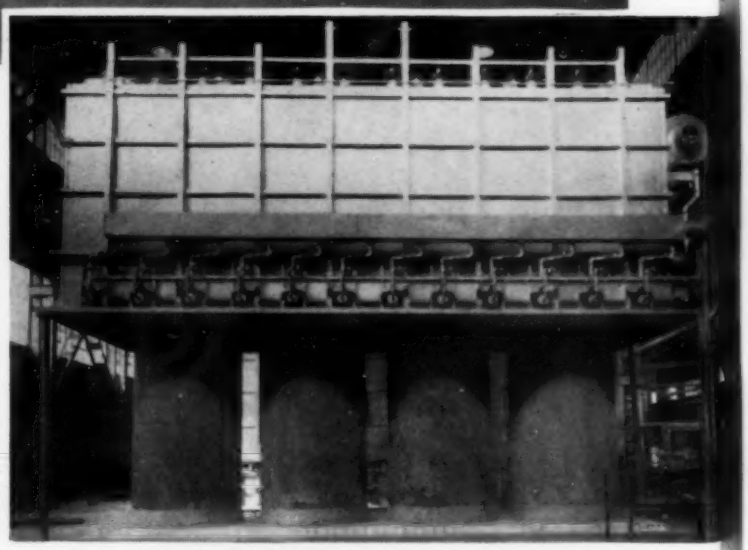
HARNISCHFEGER CORPORATION

WILSON CONVECTION ANNEALING

at GRANITE CITY STEEL COMPANY

A 4-STACK CHARGE OF SHEET COILS
60" DIA. - 135" HIGH

This 4-stack Wilson Radiant Convector Furnace is one of two such units at the Granite City Steel Company. Three 2-stack furnaces of this same design are also installed at this plant.



THE CHARGE FINISHED AND THE FURNACE
IS MOVED TO THE NEXT BASE

Lee Wilson

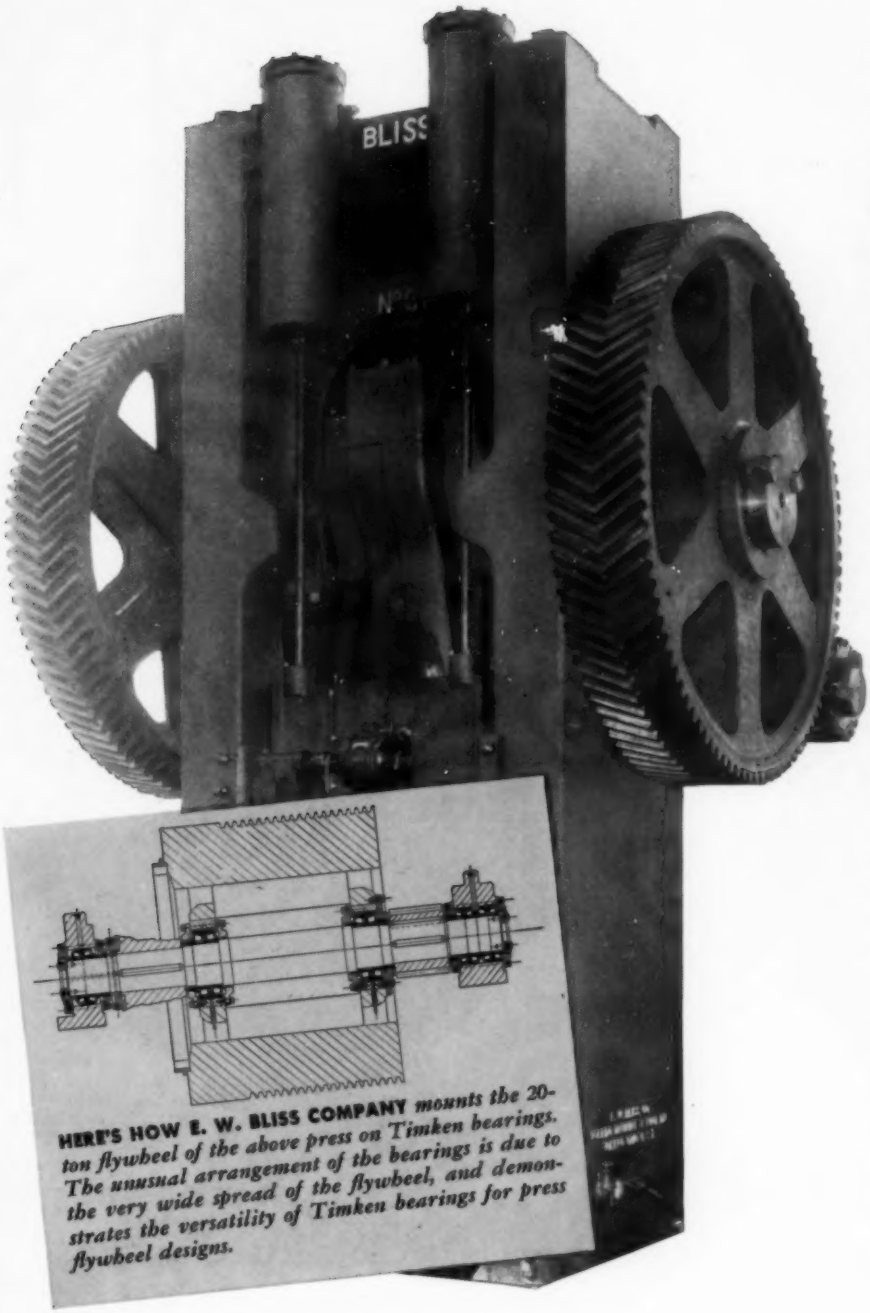
ENGINEERING CO., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES

Giant Bliss Press pulls no punches with 20-ton flywheel on TIMKEN® bearings



HERE'S HOW E. W. BLISS COMPANY *mounts the 20-ton flywheel of the above press on Timken bearings. The unusual arrangement of the bearings is due to the very wide spread of the flywheel, and demonstrates the versatility of Timken bearings for press flywheel designs.*

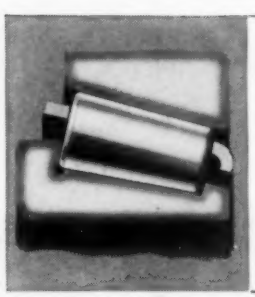
SMOOTH, friction-free rotation of a 20-ton flywheel is one of the reasons why this giant press—one of the largest of its type ever built by Bliss—packs maximum power into every punch. To carry the tremendous weight and shock loads, and to minimize power loss due to friction, Timken® tapered roller bearings are used on the flywheel shaft.

Due to the line contact between the rolls and races, Timken bearings have extra load carrying capacity. Even in unusually heavy applications like this, they continue to operate year after year with negligible wear. Made of Timken fine alloy steel, Timken bearings normally last the life of the machine.

Tapered construction enables Timken bearings to carry any combination of radial and thrust loads. They hold shafts rigid—keep moving parts in proper alignment. Effective closures retain lubricant and keep out destructive dirt, so that maintenance is reduced to a minimum. Manufactured to extreme limits of precision and finished to incredible smoothness, Timken bearings practically eliminate friction.

No other bearings can give you *all* the advantages you get with Timken bearings. Be sure you have them in all the machines you build or buy. Look for the trade-mark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

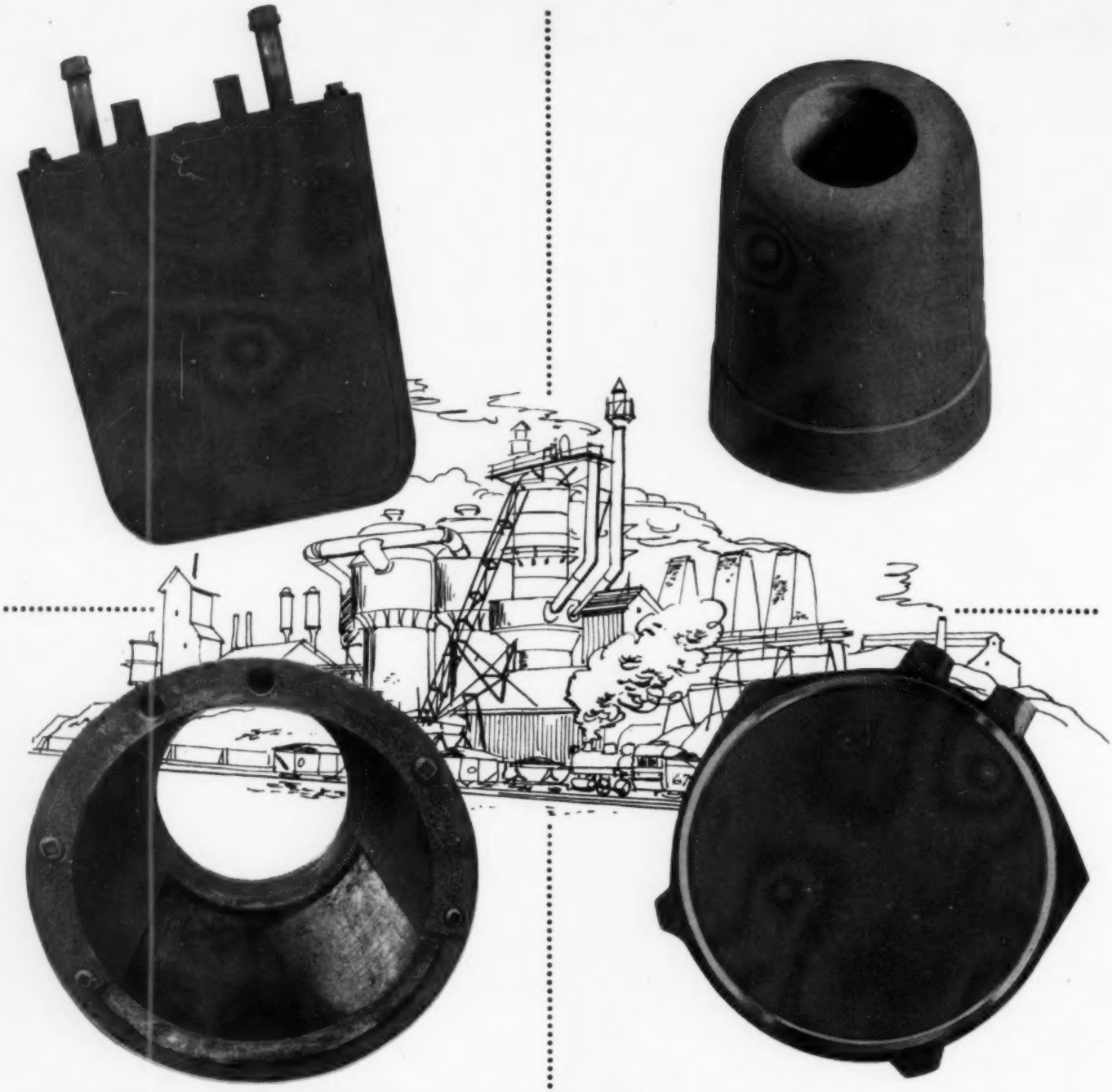
The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION →✳←



N-B-M COPPER CASTINGS . . . the right answer for greater production between stack shutdowns

N-B-M Copper Castings are the result of improved alloying and close foundry control perfected in our metallurgical and engineering research laboratories. These castings provide greater heat resistance for your most troublesome burn-out points, greater production between stack shutdowns. Always specify N-B-M Copper Castings—they give you longer, more economical service.

★

A COMPLETE LINE OF N-B-M CASTINGS

- Cinder Notch Coolers
- Bosh Plates
- Monkeys
- Stack Plates
- Tuyeres
- Tuyere Coolers
- Valves
- Valve Plugs
- Valve Seats
- Phosphorized Copper

AMERICAN Brake Shoe COMPANY

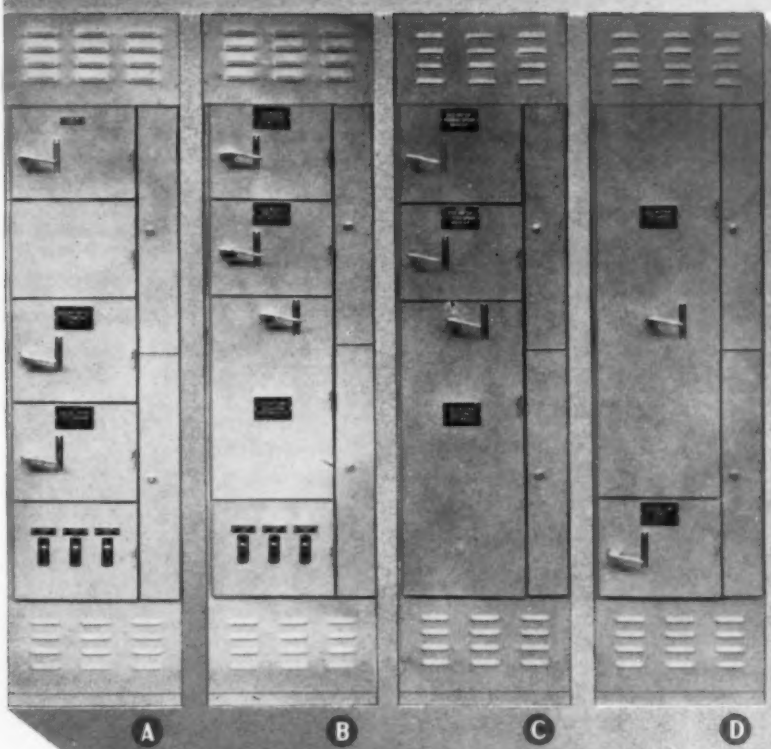
NATIONAL BEARING DIVISION

ST. LOUIS 10, MO. • MEADVILLE, PA.

PLANTS IN: ST. LOUIS, MO. • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

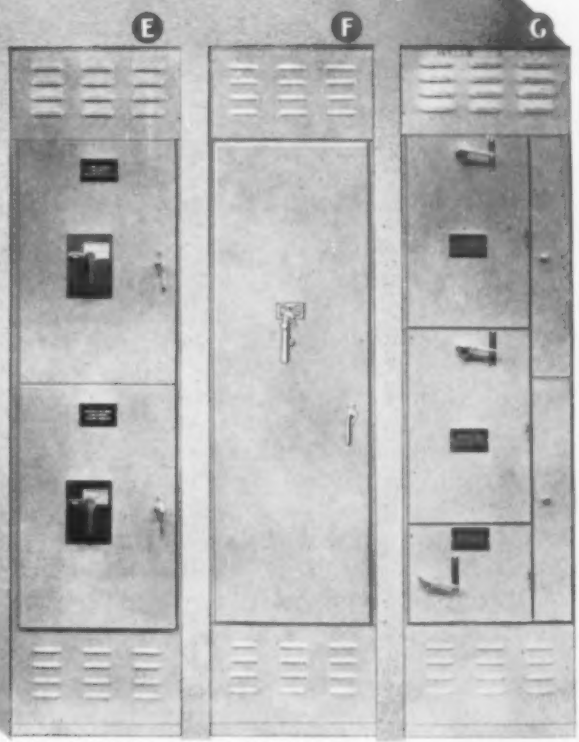
FOR *Flexible* BUT *Standardized* MOTOR CONTROL INSTALLATIONS

use CLARK CONTROL CENTERS



Any combination of sections may be erected in a straight line or in any right angular pattern to fit around corners or columns. With louvres top and bottom, total height of sections is 90 inches. Plug-in connectors, vertical bus, interlocking handles for Circuit Breakers or Disconnect Switches, locking provision on each door, easily accessible 6 inch wiring troughs and many other desirable features are incorporated in

CLARK CONTROL CENTERS



Units may be put together in any combination of sizes shown in the following table and illustrated

	A	B		C		D		E	F	G	
NUMBER OF UNITS	5	3	1	2	1	1	1	2	1	1	2
UNIT HEIGHT	13	13	26	13	39	13	52	32½	65	13	26
UNIT WIDTH	24	24	24	24	24	24	24	24	24	24	24
UNIT DEPTH	20	20	20	20	20	20	20	20	20	20	20

Ask for Descriptive Bulletin 6200

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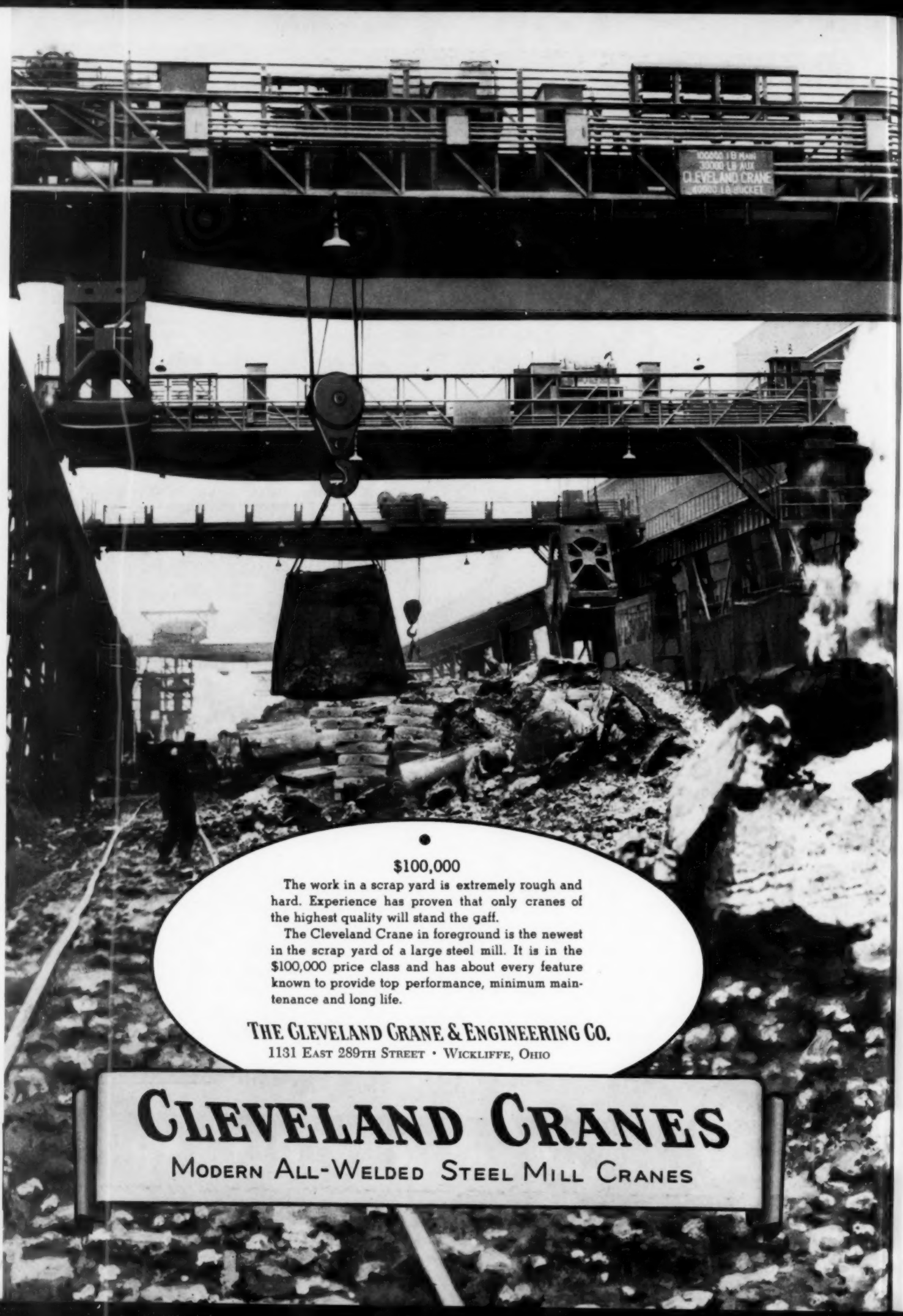

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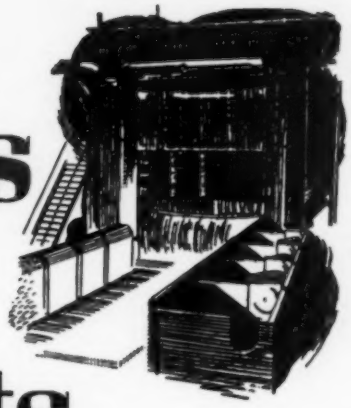


DESPITE cold shoulders given by steel producers to the proposal of a New England steel plant, the New England Council continues to work hard on the project. Present plans call for a New England Steel Authority which will sell tax-exempt bonds, to be followed by a corporation which will supplant the Authority and will acquire a plant. The projected plant will contain two 1500-ton blast furnaces and eight 225-ton open hearths, and will have an annual capacity of 840,000 tons of hot- and cold-rolled sheets. Expected capitalization is set at $240,000,000, two-thirds of which is to come from private investors and one-third from the steel company which operates the unit.

▲

ONE simple way to reduce our huge federal budget would be to let women figure it by the same methods they use in estimating their ages.

▲

JACK is a hard-working individual, with a nice family and the usual family responsibilities. He is buying a home and a car, the last baby isn't quite paid for, and, when he gets caught up, he intends to have an operation the doctor recommended some three years ago. Jack has a good job in a plant that employs about 1500 men, and through native intelligence, study, and hard work, he is in line for an assistant foremanship. Then the plant is unionized, and Jack must perforce join the union. He really doesn't want to, but join he must if he is to be allowed to stay on his job. Next, he finds seniority rules have moved him far down on the list of eligibles for the assistant foreman job. Finally, a labor-management dispute ends up in a lengthy strike. The dispute seems silly to Jack, and he wants to keep on working, but no go — he is forced to go on strike, too. As the strike drags on, Jack's car is repossessed because he can't keep up the payments. He may not lose the house, but final payment for it is deferred considerably. Other bills pile up, and his operation becomes a more remote eventuality. But everything that has contributed to wrecking his happiness has the blessing of a paternalistic government.

Now let's reverse the situation and multiply the figures by 100,000. This number of strikers in the right places can tie up 150,000,000 inhabitants of the United States. But the same paternalistic government shrinks from the thought of forcing 100,000 men to work, even in the interest of 150,000,000 individuals' welfare. Such a move is apparently wrong, even though it seems to be prefectly proper to force one man not to work.

The moral of this fable? What's sauce for one goose isn't sauce for a lot of geese.

▲

ACCORDING to Bureau of Labor statistics, 53,000,000 man-days were lost by strikes in 1949.

▲

THE first article of the Bill of Rights forbids Congress to pass any law abridging freedom of speech. Every last one of us is free to criticize — and even say some pretty nasty things about — our government, our president, and almost anyone else we choose. An employer finds it almost impossible to discharge an employee who castigates and vilifies him, if the employee really wants to stay. But poor Joe Dickmon, the 30 year old Pennsylvania coal miner, picked on someone above the constitution. He called John L. Lewis a dictator. As of this writing, Joe has been suspended from his union — and that means from his job.

It used to be that people would try to inspire youths by telling them they might get to be president. We should change that to labor leader.

▲

LUCK is where preparation meets opportunity.

▲

SOME time ago the Pennsylvania Medical Society passed a resolution for a "let-us-alone week," during which all ballyhoo and solicitation for any project whatsoever would be called off. We believe every one would welcome this. The multiplication of various causes and special funds has reached a point where no day fails to bring solicitations for money. We have no argument with the worth of the majority of these campaigns, but when solicitations reach the volume of approximately 1000 a year, we become confused and a trifle fed up — not to mention unable to respond to all.

Some funds no doubt need money desperately, while others probably collect more than they need. The general public is unable to judge whether they should give ten dollars or ten cents or nothing — and in their confusion, they are very apt to give the last.

▲

ACCORDING to John C. Munson, vice president of raw materials, United States Steel Corp., it is now estimated that iron ore from the new Venezuelan fields may be competitive with beneficiated concentrates from the Lakes region as far inland as Pittsburgh or beyond. Ore from Venezuela is expected to start moving in considerable volume in five years.

▲

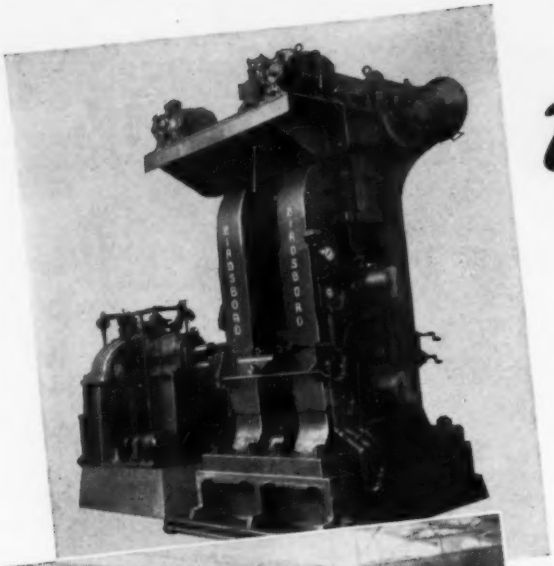
THE average man now lives 30 years longer than he did in 1800. He has to to get his taxes paid.

▲

R. E. ROBERTS, manager of employee relations for Ford Motor Co., says: "The great danger as I see it is that, although the American people are dead set against state socialism, many of them are too ready to support men and measures which eventually would lead us nowhere else. The widespread craving for security — even at the price of freedom — is causing great numbers of people to jump aboard the welfare state band wagon."

▲

COMMENT on women's clothes from a Maine weekly: "Seldom has so little been worn by so many, for so much."



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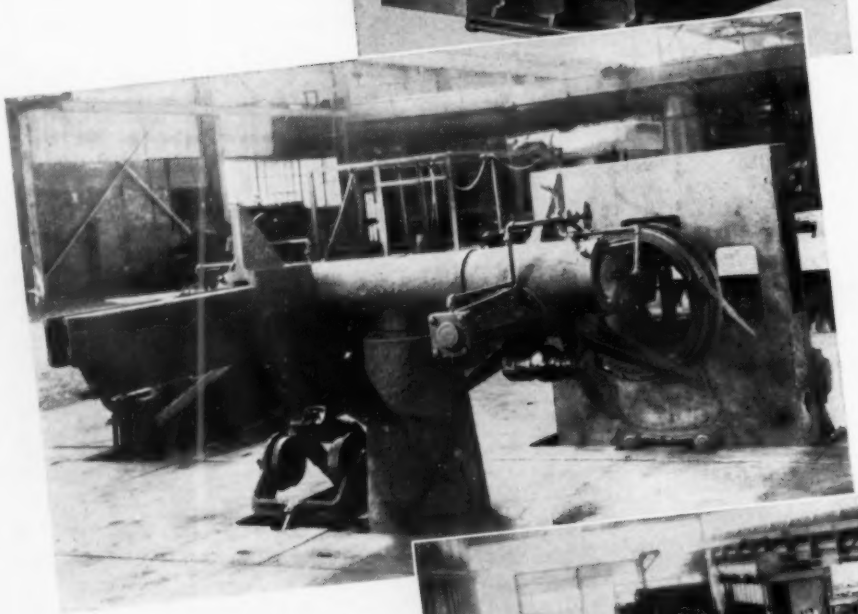

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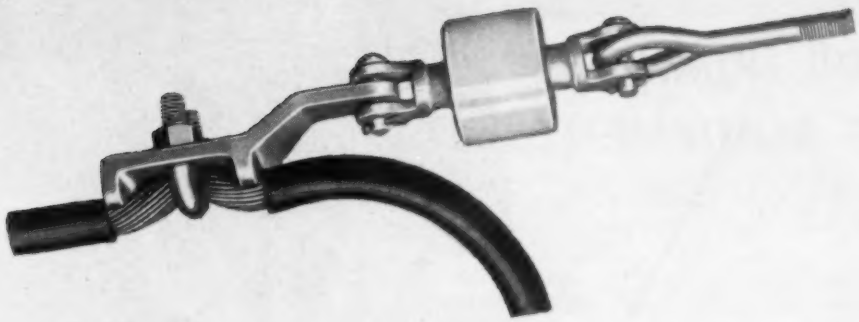

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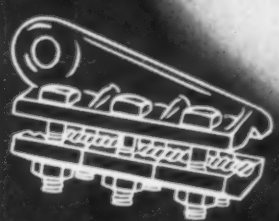
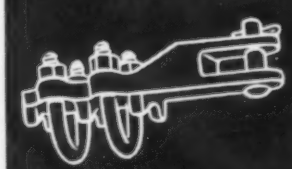


TYPE S-6 KEYSTONE Cable Strain Clamp. Similar to S-4, above, but with 6 bolts and separate clamping portions for heavy duty.



TYPE PD KEYSTONE Cable Strain Clamp. Two forged U-bolts provide increased cable grip where high strain is encountered. Bronze U-bolts for AC service.

TYPE S-4 KEYSTONE Cable Strain Clamp. Internally corrugated to assure firm grip on cable. Bronze lower half furnished for AC service.

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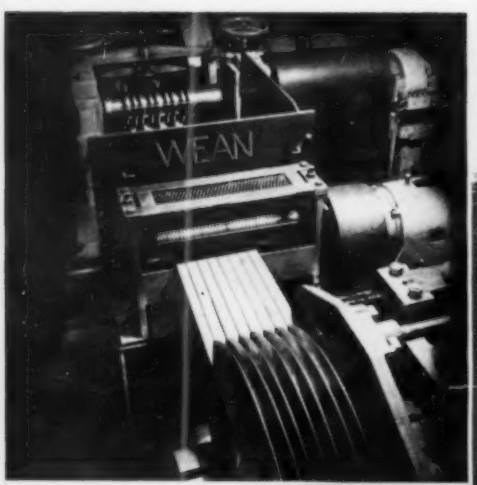

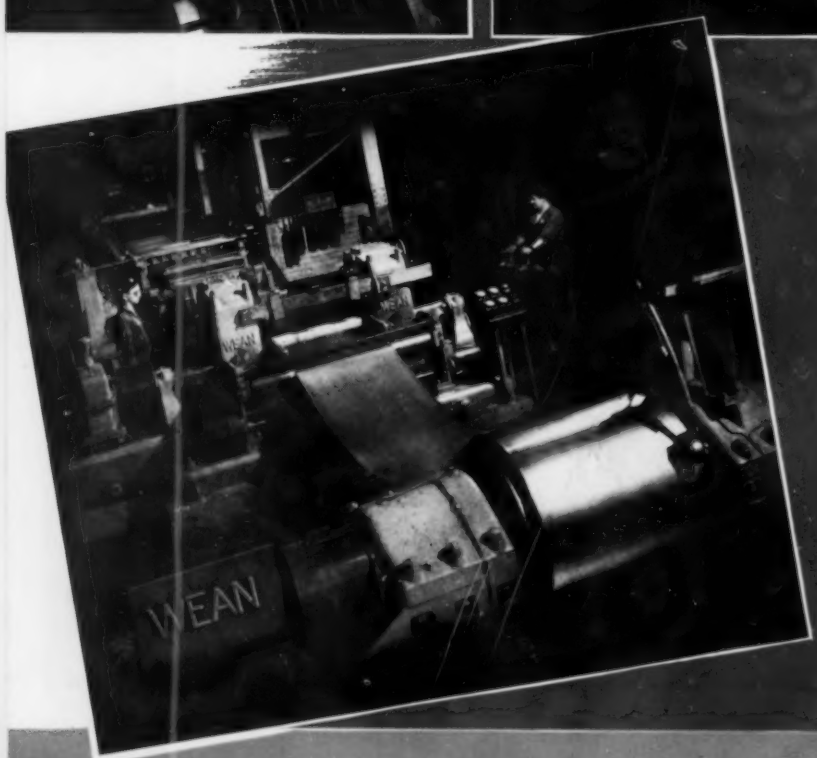

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Iron and Steel ENGINEER

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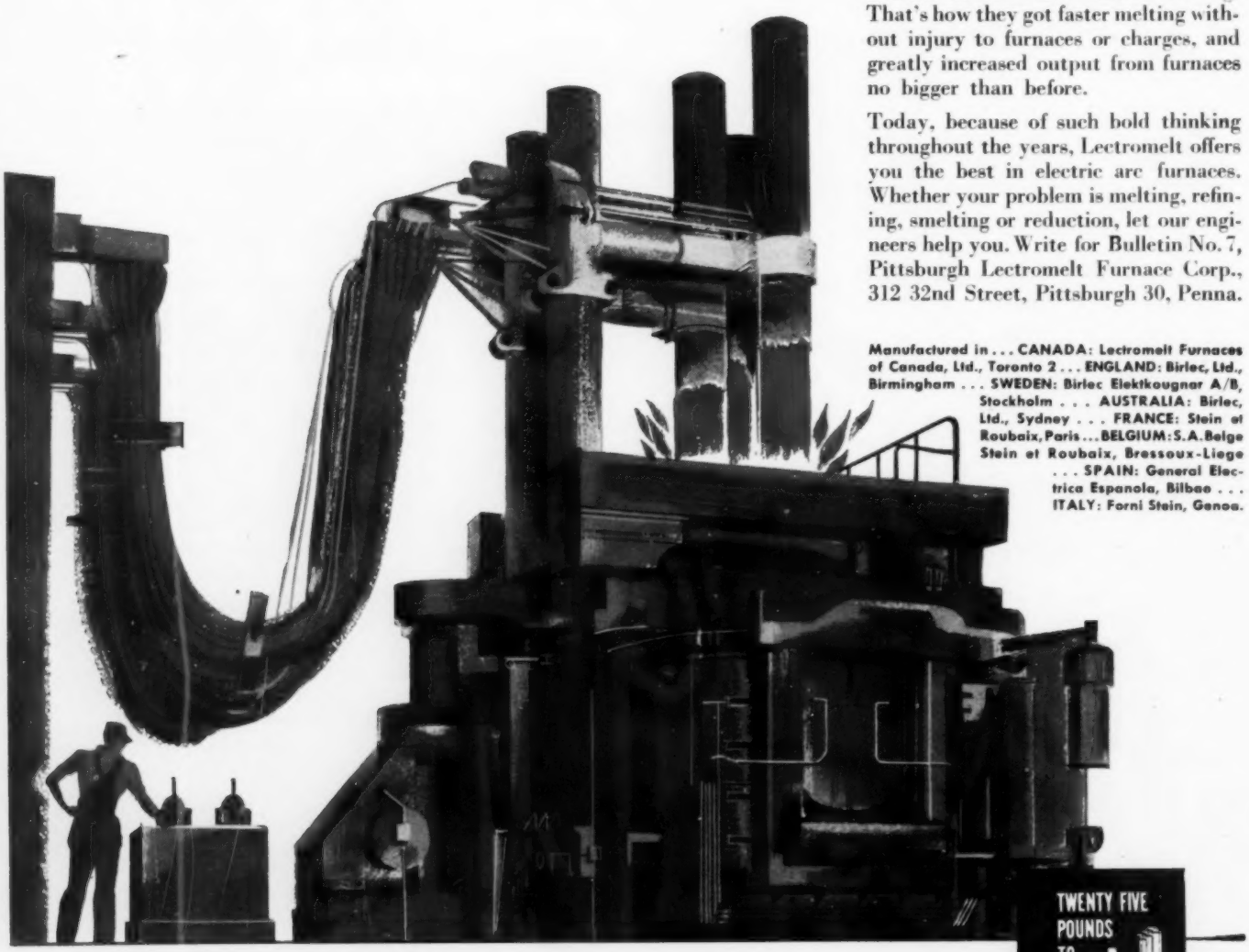

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

Design and Performance

OF LARGE ROTARY FURNACES

By A. F. KRITSCHER
Development Engineer
National Tube Co.
Pittsburgh, Pa.

. . . . the data here reported on the rotary hearth furnace is an outstanding example of what can be accomplished through co-operative research between companies . . . . .

▲ HEATING furnaces employing the principle of the rotating hearth have been known to nearly every branch of the steel and non-ferrous metal-working industries for many years. Prior to 1940, the rotary hearth furnaces had a solid hearth and a centrally located "dead man" pier, and were usually smaller than 25 ft in outside diameter, having a production of less than 15 tons per hour. It is only within the past ten years that the larger heavy production type of unit has been developed. These large tonnage furnaces can be distinguished from their smaller predecessors by their doughnut shape. An example of the size of a large unit is given by the following dimensions: For a heating capacity of 40 tons of steel per hour, the outside diameter is 75 ft, the width of the hearth is 15 ft-6 in., and the distance between the inner and outer walls across the hearth is 16 ft-6 in. Either a sprung arch or flat suspended roof may be used between the inner and outer wall.

Due to the versatility of application of this furnace and its adaptability to a wide variety of conditions, this discussion will be limited to the heating of solid steel rounds in the comparatively new large heavy production doughnut type rotary furnace.

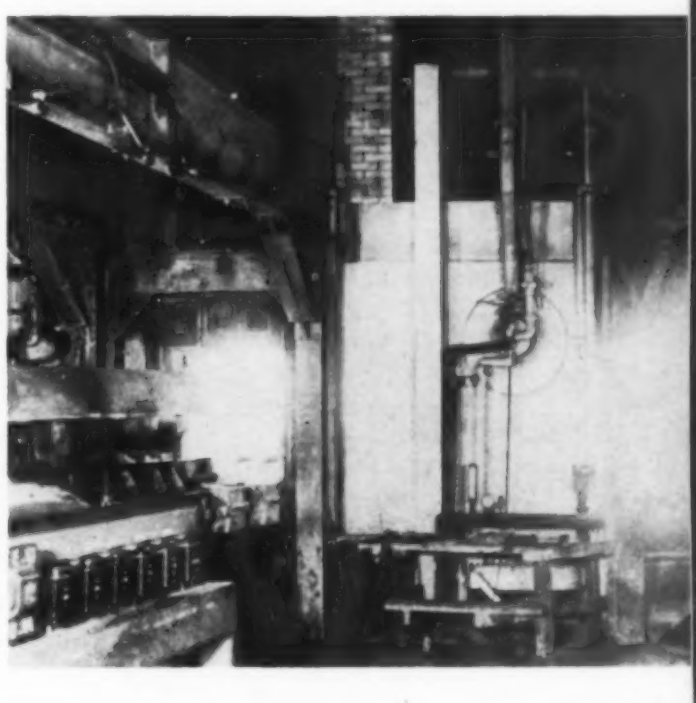
With reference to design of the heavy duty unit, the knowledge and experience gained from building and operating the smaller furnaces at National Tube Co., Christy Park Works, contributed greatly to the success of the larger installations.

It was the steel and tube division of the Timken Roller Bearing Co., Canton, Ohio, who first successfully applied the rotary hearth principle for heating billets for their tube piercing mills. The original furnace is still operating successfully at Wooster, Ohio.

This application was immediately recognized as an improvement of one of the most critical operations in the seamless tube industry, supplying an evenly heated round for piercing into tubes.

Prior to this installation, the tube industry heated round billets in conventional roll-down furnaces. The working conditions around these units were extremely difficult due to the intense heat from the operating doors, spaced along both sides of the furnace, through

Figure 1 — View of rotary furnace showing charging door and mechanism on left, and discharge door on right.



which hooks were inserted to manipulate the steel along the hearth. As the billets rolled down the hearth, the scale jackets would be broken off in spots, allowing secondary scale to form. This heavy scale was formed largely by air drawn through the discharge end doors, as well as the side manipulating openings. Furnace pressure control cannot be successfully applied to this type of furnace because the stack effect of the sloping hearth causes excessive "sting-outs" at the charging end of the furnace. The scale loss is close to 3 per cent.

A large labor crew of experienced manipulators is necessary to properly roll the rounds down the hearth, but, even under the best conditions, an ideally heated round is not provided for the critical piercing operation. Control of concentricity and surface quality in the finished product depends very largely on the result of this first piercing operation, which in turn is largely dependent on uniformity of heating and consistency of scale deposits.

It is thus easily seen why the tube industry has wholeheartedly accepted the rotary hearth furnace which offers uniform heating along with lower labor costs and increased capacity.

With many of these furnaces built throughout the seamless tube industry, and many more to be installed, there is a difference of opinion among engineers and operators as to what is or should be the best design for their particular work.

The basic design of rotary hearth furnaces, large or small, is extremely simple. The circular refractory topped hearth, a continuous construction of multiple sections, each of which is supported independently on a main spider frame, rotates upon wheels. These wheels travel on a circular track fastened to a foundation structure. The Babcock and Wilcox furnace at Beaver Falls is constructed with the wheels fastened to the foundation and the track attached to the rotating hearth. This construction facilitates lubrication of the wheels.

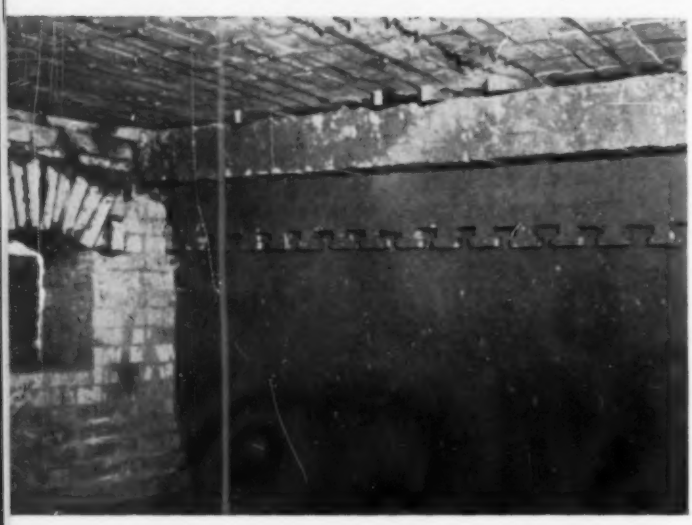
The outer wall is retained by a steel shell. The inner is fastened to a steel shell and is held in place by wall ties since both walls of the doughnut design tend to move outward with expansion. As previously mentioned, the roof may be a sprung arch or flat suspended roof. Fuel burners are fired through both the inner and outer walls.

A charging door is provided through which the cold steel is mechanically and automatically placed upon the hearth by a charging machine. After moving approximately 345 degrees through the hot furnace, the hot steel is mechanically removed through a discharge door by a similar remotely controlled machine. See Figure 1. A baffle is provided between the charge and discharge doors, Figure 2, which are 15 degrees apart, to prevent the cold steel charged from lowering the temperature of the heated steel.

Most of the important parts of the mechanical handling equipment are so located that they are not exposed to elevated temperatures.

Recognizing the desirability of properly applying the rotary furnace principle to the production of seamless tubes, a rather unusual undertaking was agreed upon by three of the larger producers of seamless tubing. The Timken Roller Bearing Co., Babcock and Wilcox Tube Co., and the National Tube Co. all have large modern rotary hearth furnaces in operation. Each of these companies have units designed for their specific needs and large investments are involved. It was felt that a study of design features and operating practices would not only benefit the interested companies by exchange of information, but would also help to establish basic data for future installations throughout the steel industry.

Figure 2 — The baffle walls will localize the hot sections of the rotary furnace and this is very desirable on small orders and special grades of steel.



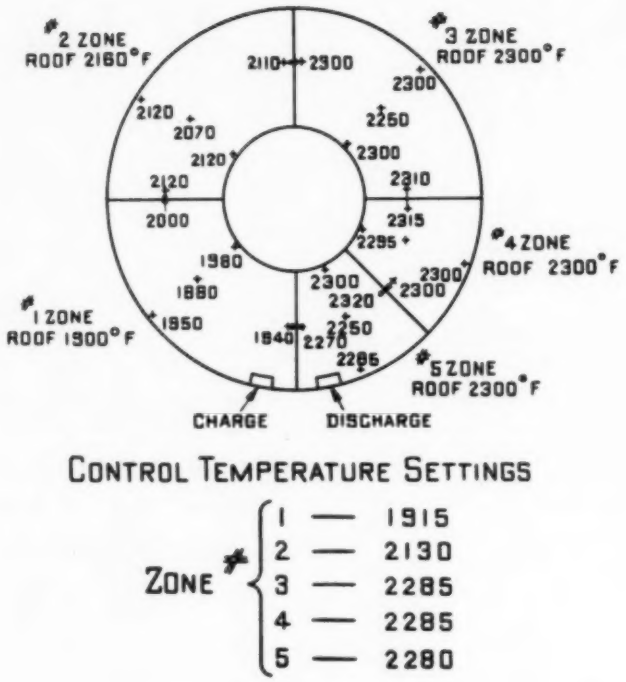


Figure 3 — Typical hearth roof and side wall temperature distribution, as well as the control temperature settings, in a multi-baffled rotary hearth furnace are given in this sketch.

By the utilization of temperature measuring equipment made available by the U. S. Steel Research Laboratory and National Tube Co. Research Laboratory, a series of tests were run in which the inside and surface temperatures of various types of steel billets were recorded throughout the heating cycle in several of the furnaces, Figure 3. At the same time, corresponding hearth roof and side wall temperatures were taken.

From the results of these test runs, it can be definitely stated that proper furnace design and operation afford ample flexibility for properly heating any grade of steel which can be pierced into tubing.

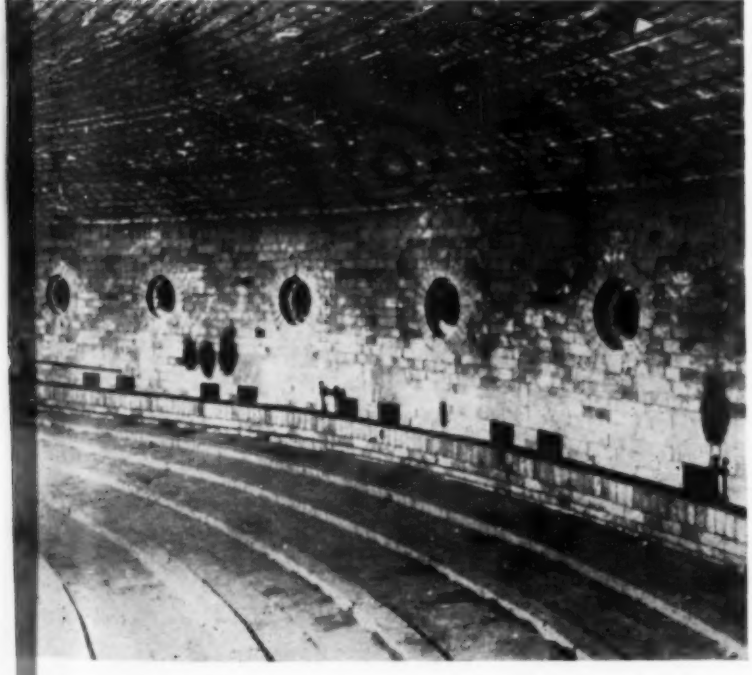
One of the characteristics of a rotary hearth furnace is the relatively high temperature of the hearth (approximately 1750 F) upon which the cold steel is charged. Since hot steel has been removed from the hearth a few minutes prior to charging cold steel, the hearth temperature has had little time to lose much heat either by radiation or conduction. Opinions are varied as to whether high carbon and alloy steels can be laid on a hearth of this temperature without any detrimental effect.

Many schemes have been suggested for lowering this hearth temperature, but a test conducted on SAE 52100 steel rounds definitely demonstrates that this type of material can be placed on a hearth measured at 1735 F and successfully heated and pierced into excellent tubing.

Actually, the steel does not fully contact the hearth since it is placed on refractory brick piers in the form of annular rings shown in Figure 4, which support the steel approximately 2½ in. above the hearth proper. The refractory points of contact quickly lose temperature and thus practically all the heating is done by radiation.

With the definite assurance that the desired steel can be heated and processed into a good product, the best arrangement of heat control throughout the furnace must be designed into the unit. The variations or modifications of temperature and zone control will vary according to the variety and number of different steels to be heated.

Figure 4 — The steel rests on refractory brick piers in the form of annular rings.



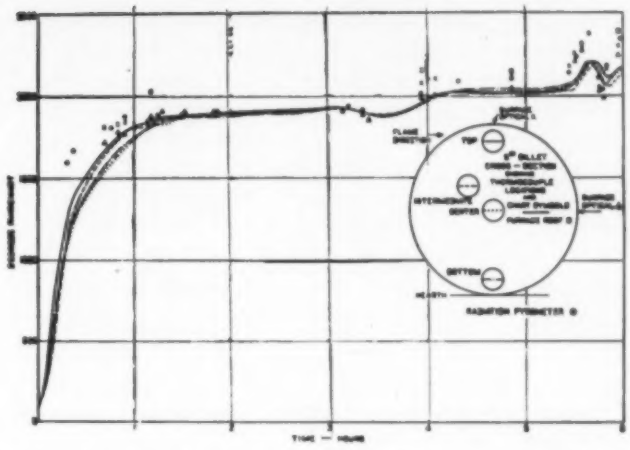


Figure 5 — The billet temperatures in a continuous furnace are given in this chart, which represents the readings given by thermocouples and optical pyrometers.

For example, the large rotary furnace feeding the high capacity pipe mill at Lorain Works, National Tube Co., heats one type of steel for a mill which has a rather constant tonnage per hour. On the other hand, in the tubing specialties division of the same company, there is a similar furnace which must handle practically every known grade of steel for conversion to tubes on a basis of 50 per cent operating time due to small order and mill changes.

In the first case, the heat pattern is practically constant. The steady operation of the mill produces stabilized conditions so that the steel does not "soak" very long at piercing temperatures. Even with unpredictable mill delays, the grade of steel processed is not greatly damaged by holding at forging temperature an excessive length of time. The only bad effect is the increased scale loss which is a factor of time and temperature.

Thus, the arrangement of necessary instruments and burners for heat control may be of the simplest design and combination. The most important factor in a simple control arrangement is the location and size of the burners, determined by the type and amount of material to be heated. The burners, designed for gas or oil, are operated in independent groups or zones.

The furnace to handle alloy steels in small quantities must necessarily be more versatile. Not only must small orders be handled, but also large tonnage items. The large tonnage items will establish their own heat pattern due to steady operation, and the heat input remains steady in each zone. As long as the hot steel is steadily removed from the furnace and colder steel advances around the furnace, a suitable time-temperature heat relation exists within the steel. However, if, for some reason, the hot steel is not steadily withdrawn, and although the combustion control reduces fuel input to its minimum rate, the accumulated heat in the discharge section tends to equalize itself and moves around toward the colder section of the furnace, toward the charging zone. In some cases, over one-third of the furnace back from the discharge door may have billets lying on the hearth at a temperature very close to 2200

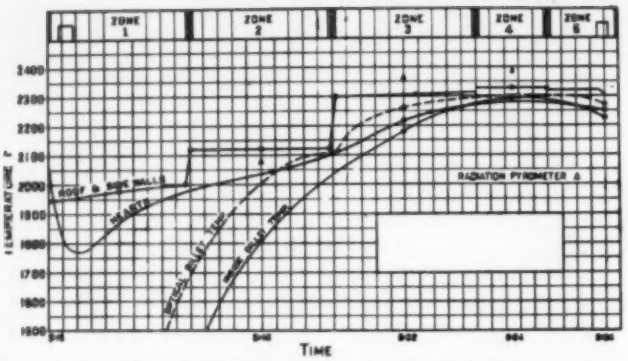
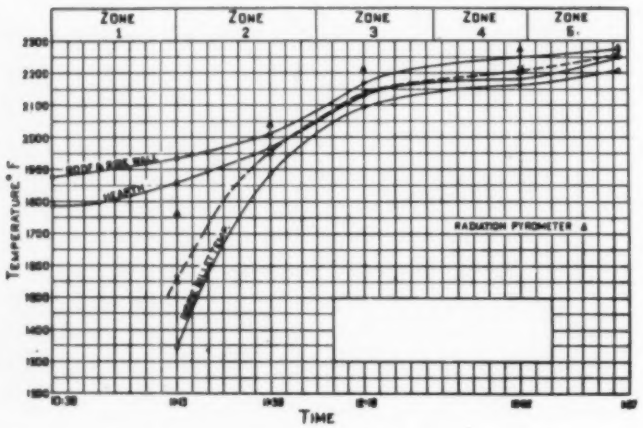


Figure 6 — The heating curve of a multi-zone furnace heating 4½-in. diam SAE 1015 rounds is given in this chart.

Figure 7 — The heating of SAE 4619, 5-in. diam, steel rounds is illustrated by this graph.



F. This condition would be detrimental to high alloy steels.

It is desirable to hold back or localize the hot section of the rotary furnace for a unit heating small orders and special grades. This can only be done by baffle walls and proper flue locations. Alloy steels should be heated in a manner in which the desired forging temperature is attained while the steel is still absorbing heat. This means that a long soaking period is not desirable.

In the most recent design, the rotary furnace has been divided into five separate zones, each section baffled from its neighbors, and each zone equipped with automatic combustion, pressure and temperature controls. If the doughnut shape were severed between the charge and discharge doors, and laid in a straight line, the picture would simulate five separate furnaces, end to end, with the steel progressing from the first to the last. Each unit is at a progressively higher temperature, and the steel is "step heated" to each furnace temperature. By this means, the steel never assumes a temperature greater than the section in which it lies. Since the last two heating sections are smaller than the others, the steel is never at final forging temperature very long.

In operating a furnace of this type, the furnace pressure control and combustion ratio control functions are very important to scale control. The average scale loss has been decreased from 3 per cent in the conventional roll down furnace to less than 2 per cent.

Having such flexibility available within the furnace permits temperature variations to be held to a narrow margin of control. The justification of the expenditure to equip a furnace with complete control equipment and baffles depends upon the value of the steel to be heated and also the frequency of mill production interruptions.

If high value alloy steels, such as 18-8, are to be heated to closely controlled requirements, the additional investment to provide flexibility and protection from overheating and from resultant product loss can readily be justified. The value of one heat of alloy steel would more than cover the expense of controls or baffles.

Due to the large floor space requirement and the big investment involved, we find that each mill has but one furnace of this type to supply heated steel for the adjacent rolling unit. These furnaces have supplanted at least two continuous hand roll-down units. Thus, the furnace is usually the pacing unit for production. The fact that the steel temperature cannot be greatly varied between neighboring pieces on the hearth, coupled with the large amount of heat stored in the surrounding refractory walls and roof, requires that the operation of a rotary furnace be a carefully planned procedure.

The large rotary furnace at Timken operating on alloy and high carbon steel involves ingenious scheduling of charging cold steel in relation to mill operations. The operating and charging schedules are so tied together that the hearth is constantly rotating. If mill changes are planned during the day's operation, vacant spaces are left on the hearth. This control system maintains a desired time-temperature curve and a low scale loss. The above method of charging replaces the heat control flexibility available in the multi-zoned furnace.

When the high temperature zone of an unbaffled furnace extends too far around the chamber, the only means for retaining the desired heat pattern is to blow cold air into the locality which has exceeded the set temperature. This oxidizing atmosphere will increase scale formation, so if the temperature of a zone must be dropped, a hearth section should be left vacant at the proper time and the cold air introduced over this vacant section.

In their seven years of operating experience, the Timken Co. has developed a system of hearth speeds and zone temperature settings for various steel grades and sizes, all scheduled and correlated with the mill operations and delays. The charging of cold billets at the proper time, proper spacing on the hearth, empty spaces on the hearth to correlate with expected mill delays to accomplish continuous rotation and consistent heating, constitutes quite an ingenious feat, and the development of this technique has been responsible for the operating success of the rotary furnace.

Installation of baffles and furnace pressure control eliminates the necessity for a constantly moving hearth. Any individual furnace zone provided with sufficient burner capacity can provide a suitable temperature head within the zone. Baffles can separate different temperature heads. Combustion and furnace pressure control will prevent excessive scaling. If the temperature control pattern is set, the surface of the steel will assume this temperature with the center following closely behind. To maintain a constantly rising steel temperature, sufficient burner capacity must necessar-

ily be provided in the final zones. Proper scheduling is essential but delays resulting from mill changes and breakdowns are not as critical.

It was to verify the results of different operating techniques and to determine the benefits of the additional expenditure on heat controls that a series of tests was made.

A group of runs were made with drilled billets placed on the hearth by the charging machine, and as the billets passed around the furnace measurements were taken at inspection doors, usually situated in each zoned section.

After tests were made at Gary Works, National Tube Co. and Gambrinius Works, Timken Roller Bearing Co., the collected data were graphed and compared. Several things became evident. The surface readings, taken by a special shielded radiation instrument set directly on the steel, recorded higher temperatures than control instruments or optical readings indicated. It was hard to believe that the calibrated instrument was in error. Then too, the center and surface temperature deviated from each other too widely. If the surface temperature was correct, the center must necessarily be of a higher temperature than recorded because the time lag could not be that great. Since the center temperature was taken by a platinum-platinum rhodium thermocouple in a center hole drilled at a depth of at least four diameters, these readings should have been accurate. Therefore, it must be assumed that some item must have been affecting the surface readings.

A side test was made on 5-in. diameter steel by inserting four thermocouples into a round. The top couple was ⅛ in. below the surface, the bottom couple ⅛ in. under the surface and the intermediate couple was between the center and top couples. See Figure 5. The surface reading instrument was calibrated to the top couple. All four thermocouples were recorded by an oscillograph.

Figure 1 is the picture of all four different couple readings with the surface reading indicated by circles. The steel was placed in the rear of a hot continuous roll-down furnace shielded from the direct flame and held until the temperature stabilized within the steel. Surface readings were quite erratic during the temperature rise which may be attributed to high skin temperature of the steel.

Upon holding the steel at temperature for a long period of time, there is an indication that as the scale formation increases, the surface reading of the scale increases. As the fuel was slightly reduced and the temperature of the furnace gradually decreased, the steel uniformly lost temperature. This indicates that hot steel can be gradually reduced in temperature without the center becoming hotter than the outside. The steel was then moved to a hotter section on the hearth with a resulting bottom temperature increasing over the center and surface temperature. It is interesting to note that while the steel surface temperature remains constant the scale surface temperature increases.

With a thick shell of scale on the billet, the fuel rate was varied to increase the billet temperature quickly and then cold air was blown through the burners to drop the temperature. The scale surface readings indicate quite a temperature drop through the scale, indicating that the scale has quite an insulating effect. The scaled surface lost temperature much faster than the billet when air was blown through the burners.

Relative to the steel temperature and corresponding optical pyrometer readings, it seems apparent that a deduction from the optical pyrometer reading should be made when the furnace temperature is rising or holding, and an addition to the reading for a falling temperature in the furnace.

Further analysis of Figure 5 may give an explanation of why there is difficulty in the direct reading of steel temperature, and also why alloy steels which do not scale readily are susceptible to surface checking.

Based on the evidence obtained by the side tests, the actual measurements are shown on the heating curves for the rotary furnace with corrected optical readings for the surface shown as dotted lines in following illustrations. The radiation readings are shown by triangular points.

Figure 6 is the heating curve of a multi-zoned furnace on 4½ in. diameter rounds. Note the effect of step heating on the surface. It is planned to investigate further the center curve with continuous oscillograph readings to see if the center curve has a similar trend.

Figure 7 demonstrates the type of heating curve attained for alloys in a zone-fired but unbaffled furnace. Figure 8 demonstrates low piercing temperature heating. Since the heating time was nearly 3½ hours, the furnace, optical and radiation readings were consider-

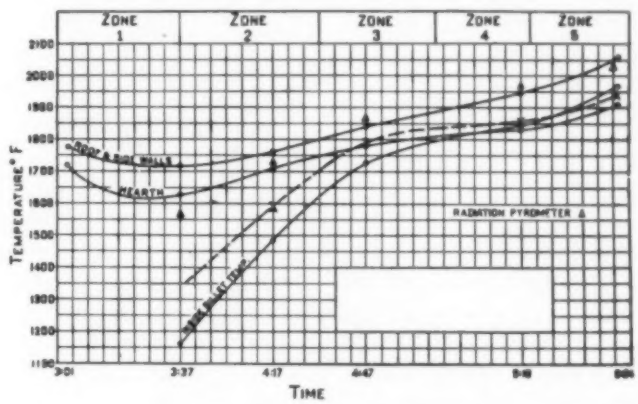
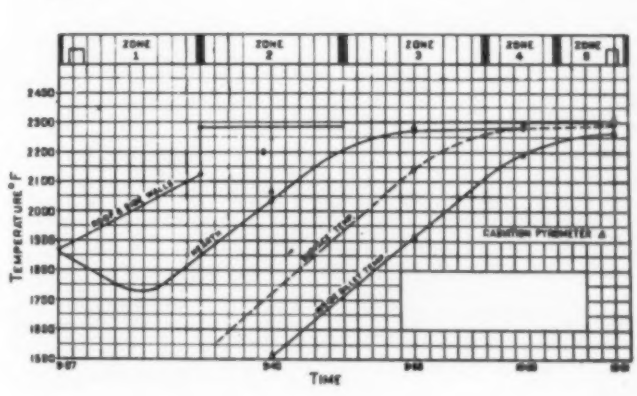


Figure 8 — Low piercing temperature heating of SAE 52100, 5-in. diam, steel rounds is shown by this chart to take about 3½ hours.

Figure 9 — Grade SAE 1015, 6½-in. diam steel rounds can be heated at a rate up to 15 minutes per inch of diameter.



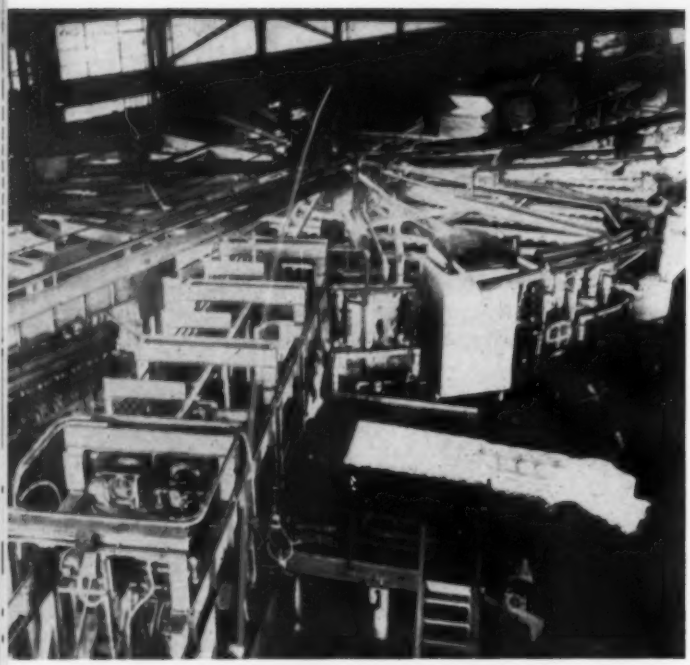


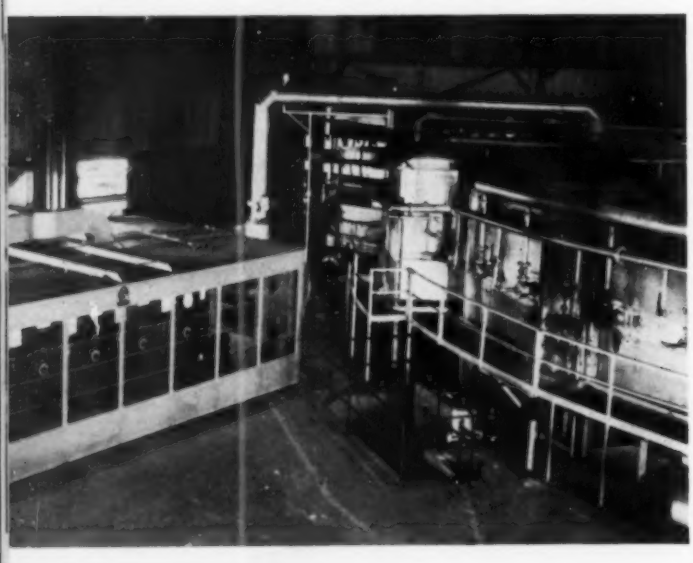
Figure 10 — This multi-baffle furnace incorporates the latest design features. Production rates have averaged better than 65 tons per hour.

ably higher than the actual steel temperature, probably due to the formation of scale.

Figure 9 shows that a 6½ in. diameter round can be suitably heated at the rate of 15 minutes per inch of diameter. It is felt that multiple baffles which permit higher temperature heads in the final zone facilitate the attainment of this heating rate.

In summation, the rotary hearth furnace can handle alloy and high carbon rounds even though the cold steel is placed on a relatively hot hearth. Baffles and zone controls afford flexibility and greater possible capacity when so desired. Apparently, present furnaces have greater capacity than originally calculated, and need not be of such a large size. See Figures 10 and 11. Analysis of operations indicate that the planned scheduling of steel charging is one of the determining factors for economical results.

Figure 11 — This enlarged view shows the control house and general area around a rotary hearth furnace.



The true temperature of the heated steel must be assumed as an approximation. To date, there are no applicable instruments to furnish true steel temperature. All optical readings vary with the furnace conditions and kind of surface on the heated steel. The center measurements by thermocouple are believed to be the only true readings taken. The test performed by multi-thermocouples should be accurate within close tolerance, but this cannot be applied to production. Closed end sighting tubes and thermocouples inserted through furnace walls are now used as measuring means, but these readings are dependent on their location and indicate only a mean reading.

An instrument to divulge the true temperature of heated steel in production operations is sorely needed by the steel industry since there is such complete disagreement as to the actual steel temperature when measured with existing instruments.

DISCUSSION

PRESENTED BY

FRED S. BLOOM, President, Bloom Engineering Co., Inc., Pittsburgh, Pa.

R. E. BUCKHOLDT, Development and Research Engineer, Salem Engineering Co., Salem, Ohio

W. TRINKS, Associated Engineers, Pittsburgh, Pa.

J. W. PERCY, Physicist, Research Department, United States Steel Corp., Kearny, N. J.

A. B. CAPRON, General Superintendent, Babcock and Wilcox Tube Co., Beaver Falls, Pa.

H. S. HALL, Assistant Manager, Combustion Control Department, Morgan Construction Co., Worcester, Mass.

Fred S. Bloom: The main subject of this paper is to determine the value of the new type baffled rotary furnace as compared to the unbaffled rotary furnace. The unbaffled rotary furnace has been in operation for at least eight years, while the baffled rotary furnace is a relatively new addition.

Mr. Kritscher concludes that:

1. The baffle furnace is necessary for heating alloys, small orders, or where frequent mill delays are encountered.
2. A large production tonnage furnace does not require the installation of baffles except for the baffle between the discharge and charging doors.

I believe the second conclusion is debatable. In our experience, the difficulty with all continuous heating furnaces lies in our inability to provide a flexible furnace temperature heat pattern. A good furnace will heat perfectly while it is heating at a fixed rate, but let this rate change, or a mill shutdown occur, then everything is upset and it takes two to three hours of operations before the correct heat pattern is reestablished.

This large rotary furnace is equivalent to a continuous straight furnace at least 150 ft long. We would

not build such a long straight of way furnace without some type of roof contour design. This roof contour design is identical in purpose to the installation of baffles on the large rotary furnace.

One of the advantages of a large rotary furnace is the ability to provide a heat pattern design to meet varying conditions of tonnage, billet size and mill delay. With the baffle construction, plus proper zone burner capacity selection, these features are ideal. You can have every zone controlled to a desired temperature without this temperature affecting the other adjacent zones.

A rotary furnace without baffles is a low tonnage heat treating furnace conducive to poor fuel economy and more scale. Figure 9 proves this. You would not wish for a better heat pattern than is provided in this slide. It shows an even temperature rise from No. 1 zone to the middle of zone No. 4, and then a slow temperature rise to the final temperature.

You cannot criticize the operation of the unbaffled furnace as shown on Figures 7 and 8, but this condition is made possible by expert operation to make the furnace work in spite of its design. It would be interesting to learn how long it took the operators of this original unbaffled furnace to develop their system of proper scheduling which alone gives them such admirable furnace operation.

We may not agree with Mr. Kritscher's conclusions regarding the design of the large rotary furnace, but we must commend him for the excellent test data which he has presented. The side test is of such importance that it can easily overshadow the main point of his paper. This test is important to everyone here regardless of their interest in rotary furnaces.

Figure 5 is one of the most important contributions to the understanding of the steel heating process that has been presented before the Association of Iron and Steel Engineers in the last fifteen years.

A study of Figure 5 will answer many of the questions which have come up in all meetings on steel heating. It will answer our problem of steel temperature measurement, soaking time, effect of hot spots in furnaces, cause for washed steel, and many other factors. Our time is too short to have a full discussion of this date.

R. E. Buckholdt: The statement that "experience gained from building and operating the smaller furnaces at National Tube Co., Christy Park Works, contributed greatly to the success of the larger installations" is definitely true. It was learned on these furnaces that it is necessary to provide ventilation under the hearth to keep the structure and wheel bearings cool to eliminate unnecessary expansion of steel and maintain lubrication of the wheels. It was also found that radial firing for a multi-zone furnace should be used instead of tangential firing, which will cause overlapping of control from one zone to the other, as well as excessive flame blow-out at either the charging or discharge door in accordance with the direction of flame travel.

Although these conditions were eliminated on the first of the larger tonnage furnaces built for the Timken Roller Bearing Co., Wooster, Ohio, methods of improving the designs were still learned on this installation. The inner wall was originally suspended from steel work overhead, which was found after several weeks of operating time to be unsatisfactory. This arrangement was made so that the hearth could rotate about a center bearing with steel members tieing from the doughnut-shaped hearth back to this center bearing. By placing the center wall on concrete supports and providing rollers in the buckstays mounted on vertical axis, the hearth was caused to rotate about these rollers as guides.

It was also found that elimination of hearth warpage could be obtained by making a solid doughnut shaped frame under which the wheels mount, and merely setting the top hearth structure upon which the brickwork is built in sections. This permits expansion of the brickwork without transferring these stresses into the main hearth frame.

These are some of the high points which our company has incorporated in the design of the present successful large high tonnage rotary hearth furnaces.

We consider the large tonnage rotary hearth furnace now operating at the Gary Works of National Tube Co. one of the finest that has ever been built.

It has been known for many years that scale on the outer surface of the billet provides an insulating layer, thus retarding heating or cooling. The information, however, discovered in Mr. Kritscher's tests reveals conditions which are a definite challenge to the manufacturers of temperature control instruments to obtain a more accurate reading of actual steel temperature rather than the surface temperature of the scale, which is only relative.

One of our more recent furnaces, although of a lower tonnage size, has been installed for the Page-Hersey Tubes Co. Ltd., Welland, Ontario, Canada.

This single rotary hearth furnace with its maximum production of 12 tons per hour has replaced four batch type furnaces that we installed for Page-Hersey in 1935. On the original installation it was considered necessary to stand the billets on end to obtain uniform heating, which is particularly necessary in the process of making tubes by the push bench method. When taken from the furnace, the billet is placed in a press where a cavity is formed with the bottom end of the billet remaining closed. Uniform heating is therefore essential so that drift of the punch will not be encountered.

On the new rotary hearth furnace the billets are laid flat on the hearth supported by annular rings of piers to permit the passage of gases underneath the billets. The billets are charged automatically three or four at a time by a magnetic charger, and removed one at a time by mechanical tongs manually operated and remotely controlled. Size of billets range from 4 in. square, 13 in. long to 6½ in. square 24 in. long. The furnace hearth is of the doughnut type, 8 ft wide x 34 ft-6 in. outside diameter. The average firing rate is 92 gallons per hour through 18 burners consuming Bunker C fuel oil. The furnace side walls and roof are lined with light refractory and the hearth is of high alumina fire brick. The heating pattern is arranged in two zones and all waste gases are caused to counterflow the work leaving the furnace at a point near the charging door. Adjacent to the furnace is a single unit needle metallic recuperator manifolded to accommodate two zones. Air is metered on the cold air side so that accurate fuel/air ratio can be easily maintained throughout the entire firing range.

The waste gases enter the recuperator at an average temperature of 1480 F and leave the recuperator at an

average temperature of 720 F. The preheat obtained for Zone 1 averages 940 F and for Zone 2, 960 F.

The average monthly fuel rate has been 14.2 U. S. gallons (2.13 MM Btu) per ton. On a run of 77 tons of the 6 x 6 x 22 in. long billet a fuel rate of 11.7 U. S. gallons (1.75 MM Btu) per ton has been obtained.

It is therefore possible to heat squares as well as rounds when lying flat on the concentric hearth piers of a rotary hearth furnace.

W. Trinks: Mr. Kritscher describes working conditions around the roll-down furnaces and points out that air must be allowed to enter through the open doors in order to make conditions bearable for the operators.

In 1925 I saw in Germany a machine which did the work. Some distance away from the furnace the operator traveled on a car which ran parallel to the furnace on inclined parts. On the car was a power operated spear which could be moved in or out, up or down and could be swung right and left. Hot gases coming out of the door did not bother the operator. In consequence, no air entered the furnace. The only trouble was that the operator had to be very careful so as not to ruin the piers between the doors.

Now with regard to rotating hearth furnaces. In 1939, I saw in the Mannesmann works in Germany a large rotating furnace for heating large rounds. It had burners inside and outside. The furnace had a lean-to. The rounds coming out the discharge door could be laid directly on the mill table or they could be moved to the soaking zone and then be placed on the mill approach table. I was told that changes in composition of steel and tube thickness were the reason for the extension.

At one place, Mr. Kritscher says: Combustion and furnace pressure control will prevent excessive scaling. This statement expresses a commonly held opinion. However, we must not forget that, at 2200 F, a reducing atmosphere produces more scale than an oxidizing atmosphere producer at 1800 F. Water vapor scales more than free oxygen. Water vapor is dissociated and immediately reassociated, except when near steel. If H_2O is dissociated, the oxygen is atomic and attacks steel much more than free oxygen, which is molecular. To prevent excessive scaling, we must heat steel by radiation and keep convection currents away. In that case, the steel is enveloped in a protective blanket of N_2, H_2 and CO.

What Mr. Kritscher has to say about the insulating effect of scale confirms what I pointed out some time ago in the discussion of a paper by Mr. Percy. Optical measurements or readings with a radiation pyrometer always indicate a higher temperature than the steel has, at least during the heating period. And when the scale is very hot, it becomes shiny and reflects the roof. In that case measurement of the scale surface results in a reading which is almost roof temperature. Mr. Bloom calls it the "glare." If the rate of heating is practically constant from one day to the next one, the temperature of the steel may be measured by a thermocouple and by a radiation pyrometer. This furnishes a correction for the reading of the radiation pyrometer. If the rate of heating varies, this method furnishes erroneous readings.

J. W. Percy: I do not think the use of baffle walls is a matter of justification, or even of debate for that matter. I believe they are absolutely necessary. In the first place, with the use of baffle walls, the temperature control is much improved, and secondly, during long delays, it is possible to keep the heat from creeping around the furnace. Both of these items, to my mind, are the criterion of a good furnace. Almost any furnace will operate well under normal rolling conditions, but it takes a good furnace and good control for operation on long delays.

There is a general tendency on the part of heaters during delays to allow the furnace to run full blast until they have a furnace full of hot steel. Then when the mill goes in again, they roll as fast as they can. They are fooling no one but themselves. This practice leads only to burnt steel, surface defects and broken rolls, with a net loss, as a rule.

There is one other item which deserves mention. I think it represents an unusual spirit of cooperation on the part of companies to allow total strangers, and competitors at that, to come into their plants and run tests on their furnaces for the sake of knowledge. It's a fine thing to do, and they should receive all due credit for it.

A. B. Capron: I agree with Mr. Bloom on his statements concerning the baffle. Our furnace is not as large as National Tubes', but it has been in operation for a longer time; it is almost two years old. The furnace, as originally installed, did not have baffles in between each zone, it had a baffle, of course, between the charge and discharge doors, and baffles between the first and second zones, and between the third and fourth zones. Shortly after the furnace was started, there was a failure in the baffle between the third and the fourth zones and, because of operating schedules, it was impossible to replace it. It has not yet been replaced.

We have found, in operating that furnace with this baffle missing, that our heat flow from the fourth back to the third zone bothers us, especially during unscheduled delays.

We operate under the same principle that Timken does in that, during scheduled delays, the hearth is left vacant, but these unscheduled delays do cause us trouble in this backward flow of the heat. At the first opportunity, we are going to replace that baffle.

Another point I would like to bring out is that in all of the larger furnaces I know, these annular piers have been installed in the hearth, but, in our case, we found that inexpert operators knocked those piers down pretty completely in the first three or four months and, to all outward appearances at this time, there are no piers left.

We have not been able to find any indication that this line contact has hurt the billets as far as good heating goes. I wonder if that finding has been so at National Tube Co.

H. S. Hall: On about the second or third curve, you showed a corrected optical reading. I would like to know what the temperature correction was.

A. F. Kritscher: In answer to the remarks of Messrs. Bloom and Percy that multiple zone baffles are an absolute necessity for large tonnage rotary furnace, it is pertinent to remember the point that to produce high tonnage from a furnace means that the minimum of mill delays are encountered.

If a rotary furnace is designed to furnish heated steel for a large tonnage mill, which seldom has mill changes

or scheduled delays, the addition of baffles imposes unnecessary initial expenses and also high maintenance cost, especially in view of reports that all baffles in the high temperature zones are failing. It is agreed that where flexibility is necessary, that baffles are required, but all tube mills in existence are not alloy or short order units, and there are several large tonnage pipe mills operating steadily with very little down time.

In such an instance, a desirable heat pattern can be maintained by use of temperature control and hand control manipulation during delays. In fact, zones (usually the charging section) can be made completely inoperative or shut off to maintain the desired heat pattern. Since this actually happens, it is further evidence of the excess capacity built into rotary furnaces. If there is sufficient burner capacity, the heat pattern can be varied or maintained without the aid of baffles.

The economic value of multiple baffle installation is a study for each furnace application, and it is believed that multiple baffles cannot be justified when production is seldom interrupted.

It is interesting to note that, of the three furnaces tested, none of the units have similar burner capacities, burner zoning arrangement, or fuel distribution per zone.

Perhaps Mr. Bloom will tell us just how burner capacities are calculated for these furnaces and why there is such a great variation among these units.

Fred S. Bloom: Mr. Kritscher states that if he has sufficient burner capacity he can vary his heat pattern to get the steel heating rate which he desires. He further states that he has found that, of the three furnaces tested, none have similar burner capacities, and he wonders why.

To understand the situation that Mr. Kritscher has found, we should realize that all three furnaces tested were engineered and built by the same furnace manufacturer. Therefore, it is logical for Mr. Kritscher to question why the difference in burner capacity, since the same engineers did the job.

In the first place, the original Timken furnace has been in operation for about ten years, and the experience gained in its operation should indicate a change in burner capacity if improvements are to be made. With the original furnace, the burner capacity was determined largely by calculation, and the design was very much like that of a heat treating furnace. The temperature in each zone affected the temperature carried in adjacent zones. It was difficult to carry widely different temperatures in adjacent zones. For instance, if No. 5 zone were operated at 2400 F, No. 4 zone could not be carried at 2200 F, because the heat from No. 5 zone would carry No. 4 zone at a higher elevated temperature. We all know how adjacent zones in any furnace affect the temperature in the other zone.

The other difference is that one of these furnaces is provided with baffles. The baffle allows any zone to be carried at a different temperature without having much effect upon the temperatures of the adjacent zones. This means that burner capacity can be calculated more accurately, and therefore the sizing of burners can be correctly engineered.

As Mr. Kritscher has stated very clearly, "if" he has sufficient burner capacity, he can vary the heat pattern to get the steel heating rate which he desires. We saw part of the answer to this "if" in the shell heating furnace lines during the war, where we never had sufficient burner capacity in the final heating zone, and consequently we had to do more heating in the preheating zones than was good for the product. In the large rotary heating furnaces this situation has been corrected, and, as a matter of fact, it had to be corrected before good operation could be attained. A lot of water has gone over the dam before the proper selection of zone burner capacity has been determined.

The modern large rotary heating furnace must be very flexible before it can provide the heating pattern which Mr. Kritscher has talked about. The furnace must be able to remain idle for long periods of delay. It must be able to heat small capacity orders, and it must be able to operate at high production rates. This takes skill in furnace operation, as explained by Mr. Kritscher in his tests at Timken. It takes skill on the part of the furnace designer to build into the unit a flexible burner system with accurate temperature, fuel/air ratio, and furnace pressure controls. With baffles the problem is somewhat simplified; without baffles the problem of burner selection is more complicated.

The selection of burner capacity should be left to an engineer with experience on this type of a furnace. It normally works out with the total burner capacity on the furnace being considerably greater than the capacity required to heat the maximum tonnage specified. The user of the large rotary furnace must realize that adding the total capacity of all the zones together is proper, but should not be used as a criterion for determining fuel rates per ton. We need zone capacities to provide flexibility in heat pattern design so that quality heating of all grades of steel can be accomplished.

As Mr. Kritscher has stated in his paper, the proper design of a large rotary furnace with the flexibility which has been built into burner capacity allows each one of these furnaces to heat more product than was originally anticipated. We can say that the furnace is too big, and in a sense that is correct. We have found out that heating in a rotary furnace with more area of the piece exposed to elevated temperatures has provided the ability to heat at faster rates than were originally calculated. In other words, the fuel engineer has missed his guesses by some 30 or 40 per cent. This is not to serious since the money expended for sufficient burner flexibility is very small compared to the total furnace and equipment investment. We should not criticise the fuel engineer for making a good mistake; after all, we allow a mechanical designer a five to one safety factor in all his calculations. If the fuel engineer could use a safety factor of two to one, he would be tickled to death. Instead of that, we expect him to be able to calculate and design an operation within plus or minus ten per cent or no safety factor. Therefore, most operations are designed on the basis of experience plus a small amount of calculations. This experience is an expensive teacher, requiring years of use and study by the operator, engineer, and furnace manufacturer.

A. B. Capron: I would like to ask if, on the chart which showed the spread of temperatures radially in each zone, the readings were taken by an optical instrument or by thermocouples?

A. F. Kritscher: They were taken by an optical instrument.

The Niagara Hudson Power System and Its Relation to the Steel Industry

. . . . operation of a power system requires careful planning and scheduling to insure efficient coordination and use of the generating equipment . . . .

By RAY T. HENRY
Chief Electrical Engineer
Buffalo Niagara Electric Co.
Buffalo, N. Y.

▲ THE Niagara Hudson Power system is made up of a large number of separate plants and systems which have been combined into a thoroughly coordinated power system. Several hundred companies have been consolidated and merged from time to time until now there are three principal operating companies, one in the Western Division, one in the Central Division, and one in the Eastern Division. These three operating companies are coordinated through the Niagara Hudson Power Corp., which is a holding company. It is expected that they will be merged into a single operating company, in which case the holding company will probably be eliminated.

The Western Division consists of one principal operating company, the Buffalo Niagara Electric Corp., and one subsidiary, the Niagara Falls Power Co., which is a consolidation of the former Niagara Falls Power Co., the Canadian Niagara Power Co., and the Hydraulic Power Co. The Buffalo Niagara Electric Corp. is a consolidation of the Buffalo General Electric Co., the Niagara Electric Service Corp., Tonawanda Power Co., and the Niagara, Lockport and Ontario Power Co.

The Central Division consists of a single operating company, the Central New York Power Corp., which is a consolidation of a number of companies in Syracuse and the surrounding territory.

The Eastern Division consists of another single operating company, the New York Power & Light Corp., which is a consolidation of a number of companies in Albany and the surrounding territory.

The area served by the Niagara Hudson System extends generally from Niagara Falls on the west to Albany on the east. It includes the northern part of the state but does not include the lower Hudson River Valley nor the Metropolitan area of New York City. The New York State Electric & Gas System supplies the area around Rochester and extending south and east and including Elmira and Binghamton.

About 85 per cent of the population of the state of New York lies within a strip about 30 miles wide, extending from Niagara Falls to Albany and thence to New York and constituting about 25 per cent of the area of the state. In the early days the principal Indian trails followed this general route. Later the Erie Canal was built within this strip, and the main line of the New York Central Railroad follows this route. It is, therefore, quite natural that the principal transmission lines of the Niagara Hudson System lie within this 30 mile strip.

Some idea of the magnitude of the Niagara Hudson System may be gained from the fact that there are over 100 power generating stations in the system. These vary from small hydroelectric stations of 100 kw capacity to the large hydroelectric plants at Niagara Falls, and the C. R. Huntley Station in Buffalo and the Oswego Station. The total installed generating capacity is just under 2,000,000 kw. The peak load in 1948 was 2,118,000 kw, and the total kwhr delivered during 1948 was over 13,250,000,000.

There are about 3,500 miles of 66,000 and 110,000 v transmission lines and over 5,000 miles of lower voltage transmission lines operating at voltages from 11,000 to 44,000.

There are about 850,000 customers not including those on the New York State Electric & Gas System.

The Niagara Hudson System is interconnected with the Hydro Electric Power Commission of Ontario at Niagara Falls, with Western Pennsylvania at Falconer and at Olean, and with the New York State Electric & Gas System at various points. In addition the Niagara Hudson System is interconnected with all of New England, except Maine, with the Consolidated Edison Co. of New York, and with New Jersey and Eastern Pennsylvania, including Philadelphia and extending as far as Baltimore and Washington. At times the total generating capacity operating in synchronism is over 12,000,000 kw.

The following tabulation shows the installed capacity in the Niagara Hudson System:

It is interesting to note there is just about the same amount of steam capacity as hydro in the entire system, and that about 60 per cent of the total generating capacity is 60 cycles.

It is also interesting to note that of the total generating capacity, 1,149,812 kw is in the Western Division,

INSTALLED CAPACITY
Kw

Hydro	25 Cycle	40 Cycle	60 Cycle	Totals
Western Division	442,825	0	81,987	524,812
Central Division	14,172	0	261,515	275,687
Eastern Division	0	20,450	161,335	181,785
Total installed hydro capacity	456,997	20,450	504,837	982,284

Steam	25 Cycle	40 Cycle	60 Cycle	Totals
Western Division	305,000	0	320,000	625,000
Central Division	0	0	270,000	270,000
Eastern Division	0	7,500	74,850	82,350
Total installed steam capacity	305,000	7,500	664,850	977,350
Total installed generating capacity	761,997	27,950	1,169,687	1,959,634

There are three 80,000 kw units on order which will bring the total to about 2,200,000 kw.

545,687 kw is in the Central Division, and 264,135 kw is in the Eastern Division.

In addition to the generating capacity tabulated above, there are a total of over 80,000 kw of frequency changers connecting the 25 and 60 cycle system together. These frequency changers make it possible to transfer energy from one system to the other as the need arises, and to make reserve capacity in either system available to the other.

In addition to the generators and frequency changers there are about 300,000 kva of synchronous condensers, and 150,000 kva of capacitors to supply reactive current and to regulate voltage.

The following tabulation shows the hydroelectric generating capacity on the interior streams in the central and northern parts of the state.

HYDRO-ELECTRIC STATIONS ON INTERIOR STREAMS

Stream	Installed capacity, kw
Oswego River	32,142
Salmon River	36,010
Beaver River	46,110
Black River	41,840
Indian River	2,265
Oswegatchie River	32,075
Raquette River	61,555
St. Regis River	7,500
Cornwall canal	2,000
Mohawk River and tributaries	114,297
Hudson River and tributaries	145,345
Tributaries of Lake Champlain	2,520
Total owned, leased and under contract	523,679

There are possible future hydro-generating sites on the Moose, Raquette and Hudson Rivers which could develop about 300,000 kw.

It is interesting to note that the generating capacity of the C. R. Huntley Station is greater than all the hydro-generating capacity in Schoellkopf Station, the Adams Station, and the Canadian Niagara Power Co. combined.

The C. R. Huntley Station is the third largest steam-electric generating station in the United States, the Hudson Avenue Station in Brooklyn with 770,000 kw, and the Hell Gate Station in New York with 630,000 kw, being the only larger stations.

The first three generators in C. R. Huntley Station No. 1 were installed in 1916. They are 20,000 kw each. The turbines operate at 250 psi pressure and 655 F. This was considered a very high temperature at that time. There is one boiler for each 8,000 kw of generating capacity.

Generator No. 64 in C. R. Huntley Station No. 2, which was installed in 1948, is rated 80,000 kw and is supplied by a single boiler at 1,250 psi pressure and 950 F. This one boiler will deliver 875,000 lb of steam per hour. The boiler for Unit No. 63, which operates at 1,250 psi and 900 F will deliver 900,000 lb of steam per hour.

The auxiliaries for generator No. 64 require about 4,800 kw. There are three 1,750-hp boiler feed pumps, two of which are required to carry the rated output of the unit. There are two 1,250-hp induced draft fans together with about 1,500-hp for forced draft and other fans. The coal pulverizing mills require about 400-hp. The pumps for circulating water through the condenser requires about 600-hp.

About 32 per cent of the potential energy in the coal is delivered as useful output from the generator. About 54 per cent of it goes into the condensing water.

Generator No. 64 uses about 0.83 lb of coal per kwhr as compared with 1.5 lb per kwhr in the oldest units in the C. R. Huntley Station.

The coal consumed at the C. R. Huntley Station was about 2,000,000 tons in 1948. This is an average of over 5,500 tons per day for the entire year of 1948. The maximum daily use is about 7,000 tons. The amount of coal in storage on the property varies from about 300,000 to about 550,000 tons. This seems like a lot of coal but even 550,000 tons of coal would last less than ninety days at the present rate of consumption.

The water circulated through the condensers is about 1,000,000,000 gallons per day, or about five times the amount required for the entire city of Buffalo.

The boiler feedwater for these high temperature boilers must be purified by distillation and chemical treatment to about one part of solid matter in a million. Even the accumulated concentration in the boilers is maintained at less than 100 ppm, which is purer than most good drinking water.

The peak load on the Niagara Hudson System for 1948 was 2,118,000 kw, which was made up as follows:

	Peak, kw
Western division 25 cycle	723,000
Western division 60 cycle	523,000
Central division 60 cycle	515,000
Eastern division 60 cycle	357,000
Total	2,118,000

25 Cycle 40 Cycle 60 Cycle 00 Cycle

Note that about 60 per cent of the total load is in the Western Division.

The difference between the peak and minimum load

is nearly 800,000 kw. There is a difference of about 500,000 kw between the peak load on a week day and on a Sunday. The difference between a dark day and a bright day may be over 150,000 kw.

The steel industry in the Buffalo area, including the steel mills and large steel foundries, require about 100,000 kw from the Niagara Hudson System in addition to about 40,000 kw generated in the steel plants. This 100,000 kw represents about 5 per cent of the entire Niagara Hudson System load, or about 10 per cent of the Western Division load. If the ferro-alloys plants at Niagara Falls are included, the total required from the Niagara Hudson System is over 300,000 kw.

The great advantage of combining the various generating stations in the Niagara Hudson System into a coordinated system lies in the opportunity to operate each station in such a way as to obtain the maximum overall benefits for the entire group.

The characteristics of the different generating stations in this system are probably more diverse than any other system in the country or in the world.

Some of them are small hydro-electric plants with little or no water storage capacity, which means that if their output is not used when water is available, it is lost forever. Others have water storage reservoirs which means that they can be operated when their output is most needed within the limits of their storage capacity. When such plants are interconnected with steam plants and the plants at Niagara Falls in a thoroughly coordinated system, their output can be used advantageously when available and the load can be carried from other sources when these hydro plants are not available.

Due to the nature of the Niagara Hudson System, there are enormous variations in the operating conditions from time to time. While there is a general similarity in the shape of the annual load curve and the output of the hydro-electric plants on the interior streams, the seasonal variations and the day-to-day variation, and even the hour-to-hour variation is very appreciable.

Under normal conditions the interchange between the Western and Central Divisions may be 100,000 kw from the Central to the Western Division during the spring run-off season and 140,000 kw from the Western to the Central Division during the dry season in the summer. The interchange between the Niagara Hudson System and New York City may be 100,000 kw to New York during the spring run-off and 100,000 kw from New York during the dry season.

The daily variations are also very appreciable. During average stream flow conditions, it is not unusual to have 80,000 kw flowing from the Western to the Central Division during the night and 100,000 kw from the Central to the Western Division during the day.

Under emergency conditions the interchange between the Western and Central Division may be as much as 200,000 kw from the Central to the Western Division, or 100,000 kw from the Western to the Central Division, making a change of over 300,000 kw in this interchange.

Similarly, the interchange between the Niagara Hudson System and New York City, under emergency conditions, may be 230,000 kw in either direction, making a change of over 460,000 kw in this interchange.

The interchange with New England may be as much as 125,000 kw in either direction. The interconnection with New Jersey may be as much as 75,000 kw in either direction.

The variations in the load and the diversity of the generating capacity and interconnections introduce some very real problems in connection with the regulation of such a system. Ordinarily the frequency is within plus or minus $\frac{1}{20}$ of one cycle, and it seldom departs more than $\frac{1}{10}$ of one cycle from normal. The accumulated time error is seldom more than 5 seconds.

Obviously such operation requires a considerable amount of study and planning. This work is done in the chief load supervisor's office in Buffalo, supplemented by the division supervisors in Syracuse and Albany.

In addition to various long-time studies and load estimates, detailed estimates are made a week in advance. Then an hourly schedule is made each day for the following day. This schedule shows the proposed operation of each plant and unit and the proposed interchange. It is based on stream flow, weather predictions, and the various operating conditions expected for the day. This schedule has to be flexible and must be adjusted during the day as conditions prove to be different than the predictions.

In addition to determining the power output of each station and unit, the load supervisors must determine the amount of reactive current required and the most advantageous arrangements for providing it. This involves the same methods as the determination of the power output.

Automatic frequency control equipment is installed at several of the generating stations in the Niagara Hudson Power System. There is also automatic frequency control equipment in New England and in the Consolidated Edison System in New York.

In the past it was the practice to assign the frequency control for the interconnected system to one or the other of the generating stations provided with frequency control equipment and to operate the other generating stations to control the tie-line loading.

In such a large system this scheme requires extreme fluctuations in the output of the regulating station. Recent developments have been directed towards spreading the duty of regulating frequency over a number of generating stations in order to minimize the fluctuations in the output of any one station.

This introduces the problem of stabilizing the system to avoid unnecessary shifting of load from one generating station to another. One method of accomplishing this is to bias the frequency control equipment in accordance with the tie-line loading. This means that the tendency of the automatic frequency control equipment to increase or decrease the frequency is modified in inverse proportion to the load on the tie-lines.

This scheme is in use in most of the major plants in the Niagara Hudson System and in many of the plants in the systems with which it is interconnected. With this equipment it is possible to spread the burden of regulating frequency over the various generating stations in the system and to avoid excessive fluctuations in the load of any one of the generating stations.

The Niagara Hudson Power System is an outstanding example of the coordination that can be accomplished in a system involving such diversity in characteristics of its various component parts and subject to such extreme variations in operating conditions.

ROLL DESIGN FOR SMALL SHAPES

. . . . comments on the design of roll passes for small shapes . . . .

By WILLIAM H. MOHLER
Superintendent, Roll Turning Department
McDonald Works
Carnegie-Illinois Steel Corp.
McDonald, Ohio

▲ HOT rolled sections or shapes are relatively common products of the steel industry. They represent a large and important part of the steel produced. The more common sections such as rounds, squares, flats, rails, and structural shapes are in evidence almost everywhere in the industrial world. But within the large scope of sizes and shapes of sections the greatest variety exists in the smaller intricate types that customarily are rolled on the 8-in., 10-in., 12-in., and 14-in. merchant mills. These are the sizes that try the skill and patience of the roll designer. Sections ranging from small structural shapes to the more intricate sections such as side rings, rim bases, window sashes, hinges, and innumerable miscellaneous items are rolled on these mills. Consideration of some of the problems encountered in the design of the rolls for this type of product is the basis of this discussion.

Small shapes and sections indicated in Figure 1 are generally rolled on mills that are specially adapted to that purpose. The Belgium type mill with two or three high stands, semi-continuous mills, and cross-country mills are used. The straight, continuous mill has definite limitations for the rolling of special shapes. Hand-fed mills in which the last end of the bar enters the succeeding pass are the most flexible and, of course, the best suited for the purpose, although not always the most productive. Housings must be equipped for suitable up and down adjustment, lateral and cross axis alinement, and also with suitable entry and delivery guide appurtenances. The designer, in his efforts to produce rolls that will turn out a high quality product to necessary close tolerances and at the same time maintain a profitable rate of production, is faced with the necessity of keeping abreast of manner and efficiency in which roll passes are working in the mill, so that this experience can guide him in designing new rolls or altering present equipment. It has been found in many cases that a small alteration in the rolls will improve production greatly. The designer therefore must constantly search for ways of improving the working of his rolls.

Before designing rolls for a new section, consideration must be given to the practicability of producing the product with respect to the limitations of the mill. Experience has shown that all mills have limitations of sizes and shapes of products beyond which operations become unprofitable. Limitations, as to depth of passes which affects the strength of the roll and width which is dependent on the size billet, must be determined. Other matters, such as thickness of the finished bar, finishing temperature, analysis of material to be rolled, must be taken into consideration. Furthermore, as a result of experience on a particular mill, the designer usually establishes limitations on details like taper, sizes of fillets, thickness and length of stems, flanges, and other features that affect the production of a salable bar.

It is the purpose of the designer to create a series of passes in the rolls which will reduce the bar in cross sectional area and in stages form the metal into the particular shape desired, at the same time avoiding

Figure 1 — A wide variety of shapes and sections are rolled on the merchant mill.

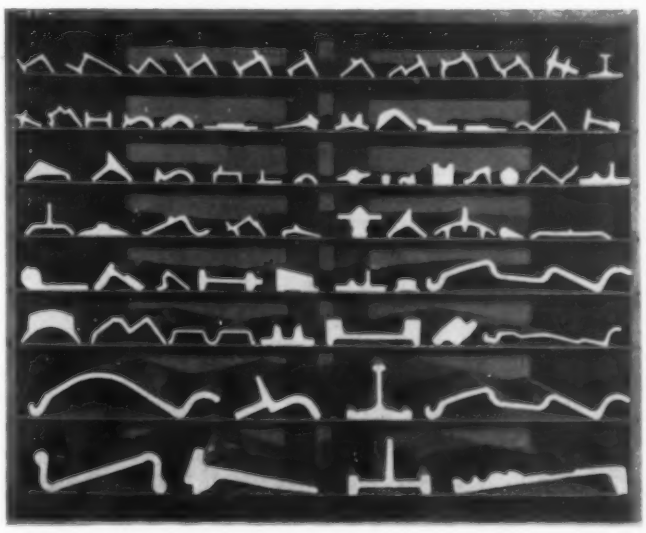
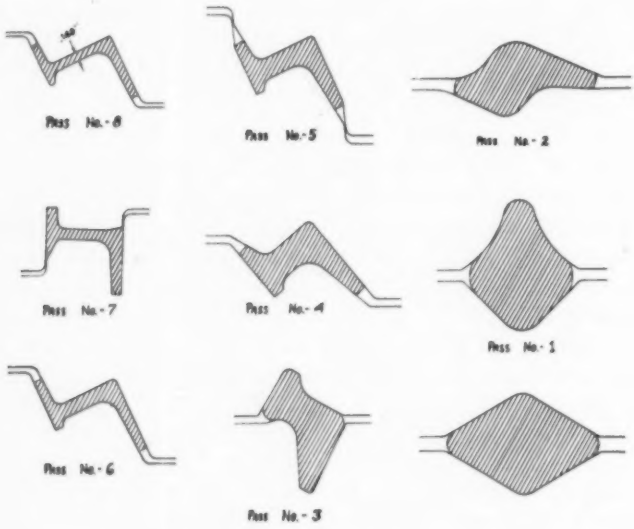


Figure 2 — The designer makes the bar to fit the pass and makes the pass to fit the bar.

Figure 3 — Eight passes are used to develop this typical sash section.



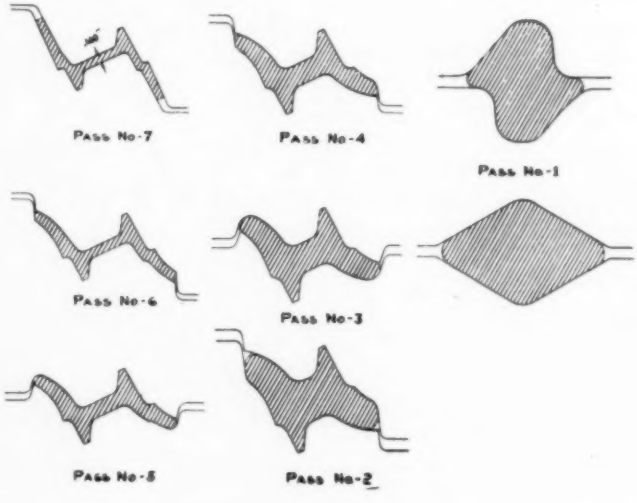
pinches, underfills, laps, grinding, undue wear and other defects which may develop during the process.

In order to accomplish this he must resort to such devices as bending flanges, edging up or using dead holes, pinch catchers, fillets, etc., all for the purpose of maintaining control of the metal during the stages of reduction in cross sectional area. In making the layout the designer uses a method that might be described as "making a bar to fit the pass and a pass to fit the bar." This is done alternately from pass to pass, starting with the finishing and working back to the first forming pass. Figure 2 illustrates how this is accomplished by superimposing each bar drawing over each pass design throughout the entire sequence of passes.

Figure 3 shows a typical sash section using eight passes for its development. Some designers may consider this too many passes, but experience has shown in the majority of the cases, too few passes result in less control, causing variations throughout the length of the bar, resulting in delays and excessive production of scrap. The finishing pass is laid over to as near 45 degrees as the inside taper on the small projection will permit and still leave about 5 degrees for relief. The more nearly perpendicular the live flanges are, the more side thrust and resultant wear on the lock collars at the end of the rolls. To reduce this wear, the pass is laid over the greatest extent possible. No. 7 pass may be termed a control pass as the dead hole shown definitely establishes the length of the flanges. These dead holes should be about 0.020 in. wider than the thickness of the flanges going through, in order to provide clearance and to prevent the bar from sticking in the pass and winding around the roll causing what is known as "collaring." The particular advantage in the use of this type of dead hole pass is that it can easily be altered to take care of any deficiency in the length of the flanges. In cases where it is not practical to use this type of pass, other methods are used to control the flange length, such as the butterfly method as will be noted in some of the following designs. No. 6, 5, and 4 passes are needed for developing the flange in addition to reduction of cross sectional area. The draft in these passes range from twenty-five to thirty-five per cent. No. 3 pass is mostly a controlling pass, and is very important in that it regulates the overall width and allots the proper proportion of stock to the two flanges. The bar from this must be turned about 45 degrees before entering No. 4 pass. No. 2 and 1 are special roughing passes and are used to mold the metal from a simple square or diamond to a suitable shape for subsequent reduction. These passes are designed so that the bar must be turned 90 degrees between stands to maintain dimensional control.

The zee sash section shown in Figure 4 requires a much different method of control and development. Due to the length of the flanges and the offset on them, it becomes obvious that the butterfly method is the most practical. Good control is achieved by alternate up and down parting of the rolls from pass to pass. The parting on one side of the flange in one pass becomes the fillet in the next pass, the fillet protecting the metal from pinching in the succeeding pass. Combination rolls are used, that is, the parting is up on one side of the pass and down on the other. Straight tongue-and-groove rolls could be substituted if it were possible to lay the section over nearer to 45 degrees off center line. The small projections are developed by dead hole rolling in all passes except No. 1 pass, where the stock of metal for them is initially formed by squeezing and spreading as shown. No. 1 pass regulates the overall width of stock due to the 90 degree turn given to the bar before entering No. 2 pass.

Figure 4 — The butterfly method is the most practical to develop the zee sash section.



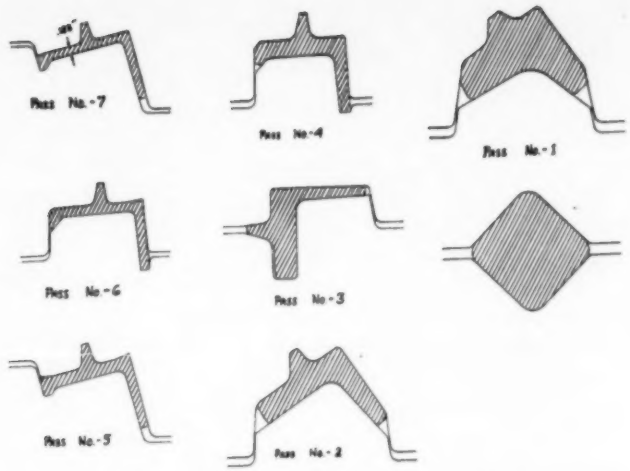


Figure 5 — The angle sash section offers many problems to the roll designer.

The angle sash section shown in Figure 5 is one of the most popular types of sash sections, but is always a nemesis for the roll designer. The taper on the small projection at the top of the bar restricts the designer from laying the section over in the rolls sufficiently to permit neutralization of the forces, which are objectionable and which cause twisting and hooking in delivery. Only by tight guide setup can a tolerable delivery be maintained. The majority of pass designs for this section are a compromise made in order to develop some of the special features required on the finished bar. Take the finishing pass, for example. The degree of angle at which it is placed in the rolls assures a bad delivery requiring precise guide setting in addition to roll setting, but this degree of angle is necessary to provide roll relief on the side of the small projection. With these types of passes, the skill of the roller is really tested. The No. 6 pass is designed with a pocket to control the length of the flange. Pass No. 5 is a general development pass but helps control the length of the small bead. Pass No. 4 also controls the length of the flange. In pass No. 3 the middle projection is developed, which subsequently is dead holed in the final passes. The flange is reduced in thickness, but the web of the bar is reduced only in width. Passes No. 2 and 1 are good reducing and development passes. In cases where drafts are unequal and reductions are greater in proportions from one part of the bar to the other, as are inherent in most of these passes, twisting or hooking will usually be the result, necessitating precise and rigid guide setups as previously implied.

There are some sections that are more intricate and have features that require more passes to develop. Figure 6 shows such a section taking nine passes. The flanges are developed and controlled by alternate live and dead holes. The wing length is controlled by up and down parting with the use of fillets. The finishing pass is laid over to get as near to horizontal rolling on the flanges as possible. The flange in the leader is dead holed to control the length. Here also clearance on the sides of these dead holes is necessary in order to prevent collaring, which in many cases results in breaking of rolls. Pass No. 7, 6, 5, 4, are laid out similar to 8 and 9 and function as reducing and controlling passes. Between passes 2 and 3, the bar is turned 90 degrees which allows good control of the amount of metal entering No. 3 pass. This No. 2 pass is a type that is very important to the roll designer, for if he finds that in rolling the bar the stock of metal on either side of the pass is too small or too great, he may, by slight alteration, accomplish the proper distribution.

Figure 7 also shows a section of the type that is very close to being impractical to roll within the desired specifications. The reason for this is that the finishing pass does not cover the entire contour of the section allowing the pass to be empty, which is objectionable as it limits control of the surface of the bar and is likely to result in distortion and variation. Since it is necessary, however, to use this type of finishing pass, then parts of the bar must be developed into the finished size in the leader or No. 8 pass. No. 8, 7, 6, 5, 4, passes are laid out with alternate live and dead holes, and with flared flanges similar to the method of rolling rails. Clearances in the dead holes as in other sections are here important to prevent collaring. No. 3 and 2 passes

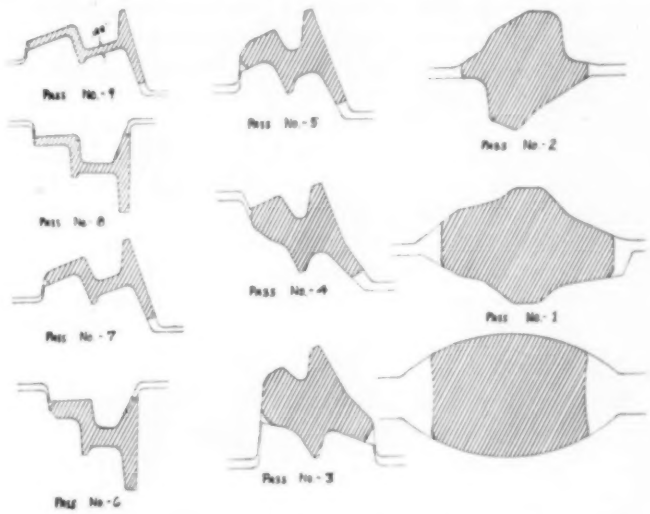
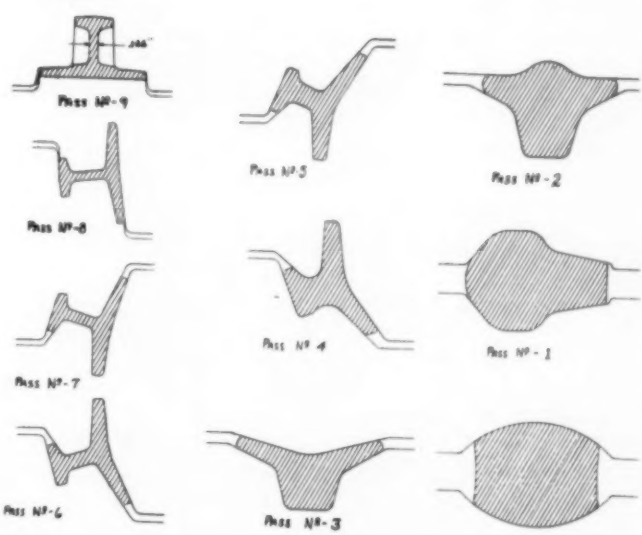


Figure 6 — Nine passes are required to develop the intricate section illustrated in the drawing.

Figure 7 — This section is difficult to roll because the finished pass does not cover the entire contour of the section.



develop the flanges and regulate the amount of stock in the head of the section. No. 1 pass regulates the amount of stock that goes into making up the length of the flanges.

Sections with shorter flanges and small projections naturally require fewer forming passes. Figure 8 illustrates a design for a side ring section using only 6 passes. The finishing pass is laid out in combination rolls, that is, one collar up and the other collar down. Considerable control is achieved by the type of pass used in the leader. The pocket confines the metal and regulates the overall width of the bar. No. 3 and No. 2 are tongue-and-groove passes giving good control of the stock. No. 1 is a simple pass that rounds the one side of a square so that the bar will fill No. 2 pass without the tendency to pinch. Such sections as this require a very complete and accurate guide setup.

Figure 9 illustrates still another problem with which the roll designer is sometimes faced. The fact that this section is made of spring steel requires special considerations. Hard steels and alloy steels have very different rolling characteristics than plain carbon steels and usually require special passes. This is especially true of complicated shapes, due to the fact that with the increase in tensile strength, there is an increase in the tendency to spread. In this particular case, power entry to the finishing pass is necessary due to the wide leader required. The leader must be wide enough to allow the entry guide to hold it up so that the bar will not roll over in the guides. Hand feeding is not possible because of the larger angle of bite and the low traction, so that section can be made satisfactorily only on a continuous

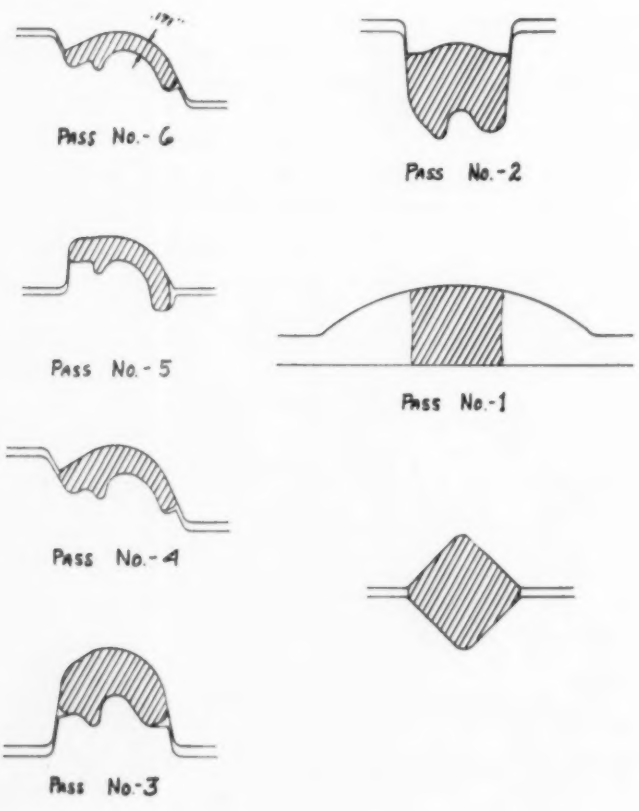


Figure 8 — Since the side ring section has short flanges and small projections, only six passes are required to roll it.

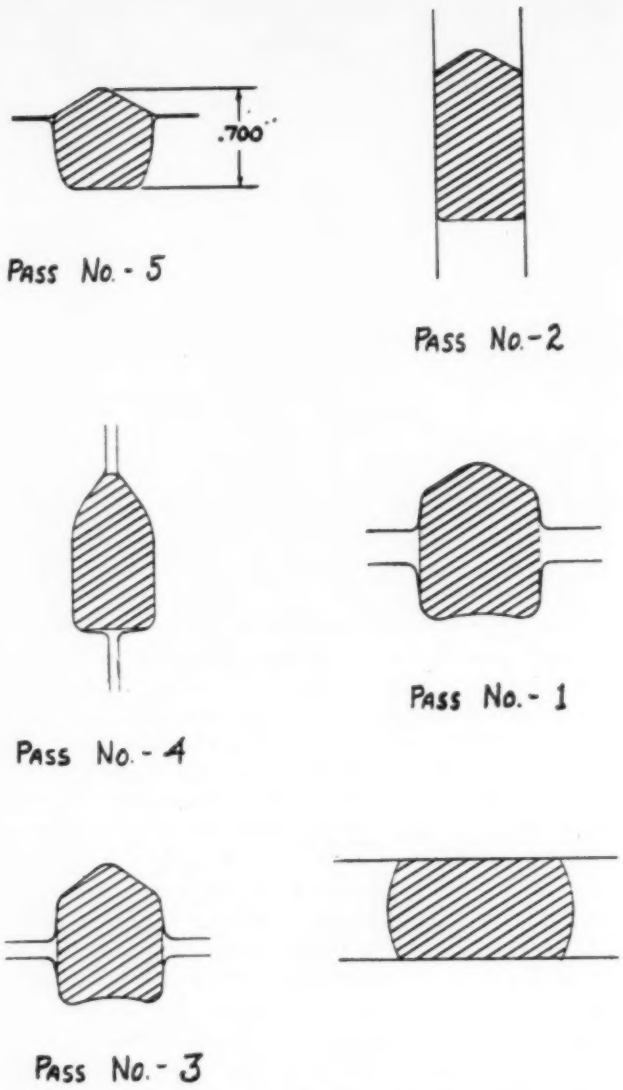


Figure 9 — The finishing pass may be a problem where hard or alloy steels are used.

mill. The designer's particular problem here is in the finishing pass only.

Sections that are thick on one side and thin on the other are known as unbalanced sections and pose a few special problems for the roll designers. They require very close proportions of draft on the various elements that make up the bar because it is the draft that determines the elongation of one side of the bar or the other, thereby directly affecting the delivery from the rolls. If the draft is greater in proportion on one side than on the other, the bar will hook away from the side with the greater draft. In other words, the side with the greater draft becomes the outside of the natural circle which would form if the bar were delivered freely from the rolls. Figure 10 shows a very clear example of this problem. The roller must also adjust his rolls very close to these specified settings in order to assure good delivery. The passes are made tongue-and-groove for better control of width, and the up and down coverage of roll partings prevents overfilling. It might be said that the spreading tendency on the thin side of the section is great and also sensitive to draft. The number of passes required to roll an unbalanced section, particularly if the unbalanced condition is the main feature, is deter-

mined by the proportion of difference in the thickness from one side to the other. The greater the difference, the more passes required.

Balancing becomes more involved when applied to an intricate shape as in Figure 11. This section might be considered as an extreme in this category. In the designing, it necessitates very delicate proportioning, especially in the last four passes. No. 4 pass is a modified edger, which helps develop the head and also regulates the length of the flange. This type of section requires exceptionally accurate adjustments of rolls to a specified setting in order to assure good delivery from each stand.

Figure 12 is not considered an unbalanced section and hooking in this case is not a problem but, nevertheless, the roll designer must balance his drafts very accurately between the heavy and light masses of metal. This balance very readily affects the spread. The greater the proportion of draft on any part of a bar, the greater is the spread of that part. Building up the central mass of metal in passes 10, 9, 8, 7, and 6 clearly illustrates the designer's effort to keep the spread of the flanges within bounds. Tongue-and-groove passes are used to give additional control of the spread and

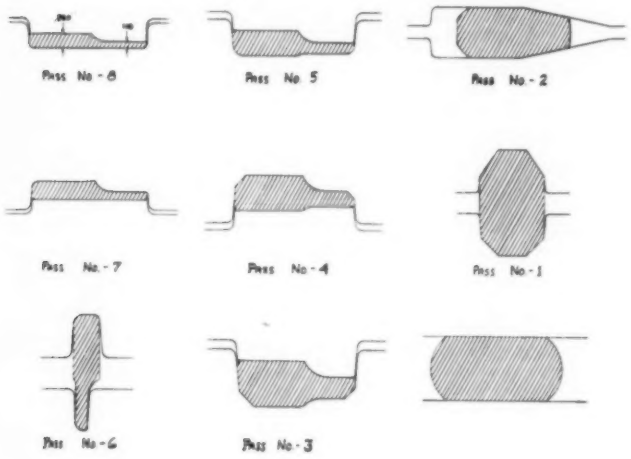
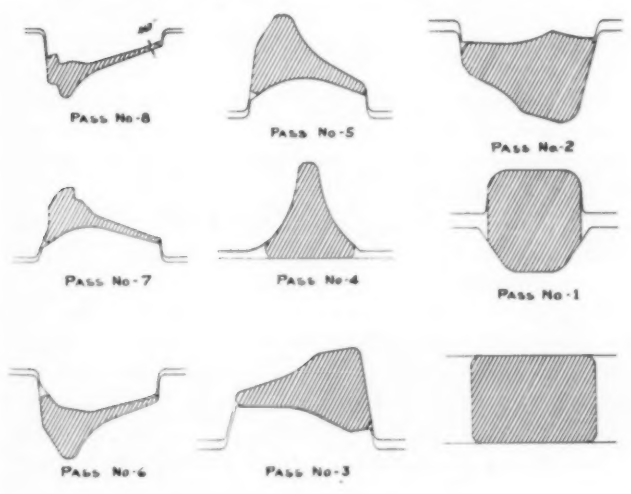


Figure 10 — Unbalanced sections pose problems because the bar has a tendency to hook away from the side with the greater draft.

Figure 11 — The section shown is very difficult to roll because balancing requires very delicate proportioning.



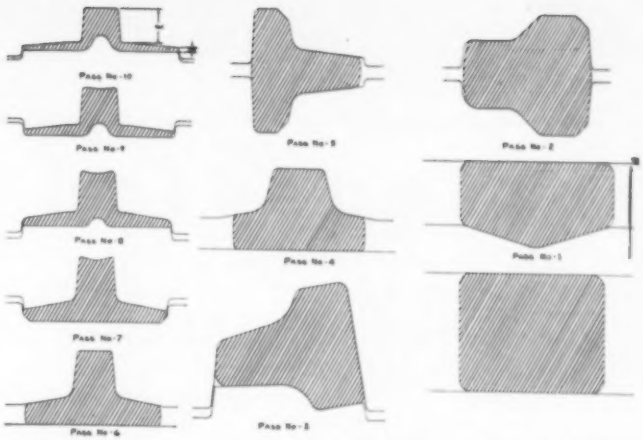
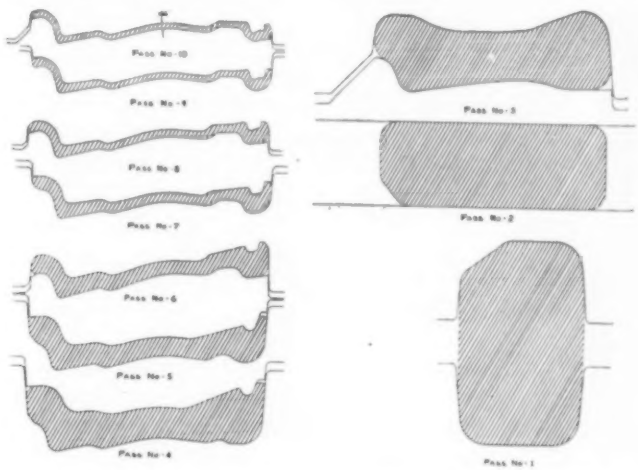


Figure 12 — The designer must balance his drafts very accurately between the light and heavy masses of metal in the section shown in the photograph.

Figure 13 — Sections which are wide in proportion to their thickness are very sensitive to unbalanced conditions.



maintain closer control of the finished bar dimensions. The roughing passes are the ones regularly used in making tee sections. The wider the section in proportion to its thickness, the more sensitive it is to any unbalanced condition. In addition to hooking, the bar will buckle and sometimes pull out of the pass if the draft is not balanced.

Figure 13 shows a rim section that is particularly subject to these effects, so the designer must use his utmost skill on this type of section. Also any slight defects in the delivery will damage the vertical portions of the tail or the gutter of the section and will result in wide variations of the finished dimensions. Tongue-and-groove passes are used to maintain close control of all surfaces of the bar as it goes through the mill. The number of shape passes is determined by the amount of form to the finished bar. A wider bar of similar form will generally require a greater number of passes.

The designing of shape passes cannot be classed as an exact science. Some may even consider it an art. Although the designer is guided by certain general principles, the majority of his work is dealing with variables which change with each particular case. Of course a formula may be developed to suit a particular case, but the designer of shapes very seldom encounters the same situation twice. Only through years of contact with the

actual problems and the use of certain fundamental principles is the designer able to make the close estimations required for this work.

DISCUSSION

PRESENTED BY

A. M. CAMERON, Roll Shop Superintendent, Atlas Steels, Ltd., Welland, Ontario, Canada

C. W. BARRETT, Chairman, Rolling Mill Committee, Republic Steel Corp., Cleveland, Ohio

LOUIS MOSES, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Co., Sparrows Point, Md.

PAUL FREY, Superintendent, Roll Shops, Republic Steel Corp., Youngstown, Ohio

BURGES A. LeMONTE, Roll Engineer, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

WILLIAM J. WALLACE, Rotary Electric Steel Co., Detroit, Mich.

A. M. Cameron: When a special shape is submitted by a customer do you analyze it thoroughly from a production standpoint and then ask for concessions that will assist in delivery of the section from the mill and also aid in greater production or less cost? For example, on Figure 5, if the outside angle on the projection were increased, then the section could be layed over more than shown and allow a much better delivery from the mill.

You have not mentioned rolling stainless steel shapes. If you have rolled stainless 302, what has been your experience using tongue-and-groove passes?

C. W. Barrett: I can readily appreciate the author's problems on the type of sections he is required to produce. I wonder if we work close enough with the customer so that he understands our problems and we know more about his? This would be beneficial to all concerned. We receive requests for special sections which are practically impossible to produce, but with slight alterations here and there may turn out to be desirable business.

Too often we will take a chance on sections that we know will be difficult to produce and which often turn out to be costly; perhaps we should do a little more consulting with our roll designers.

Louis Moses: Selected from the many hundreds of shapes rolled at McDonald, Mr. Mohler has chosen outstanding examples to illustrate the ingenuity required to roll them and the characteristics of applied drafting and bar manipulation. Among these he stresses balanced drafting which roll designers and rollers immediately appreciate. For shape rolling, in regard to achieving a straight delivery, must be performed just as accurately as when rolling wide flats where every pass in the train must produce a parallel bar.

However, the author has another meaning when he mentions balanced drafting. It is an admirable thing to exhibit to us a successful series of passes, but another problem to describe the long and patient weighing of the many components when their design was under way. He means that each part of the section must be considered individually and entirely separately from the whole, the effects of applied work to such parts to produce the desired objective, and then these all put together again in relation to other parts to produce the pass as a whole. All the parts must be worked, some more than others. The question is: To what degree will the whole bar hook, turn down? Will that lug, flange, stem or very thin termination fill out? Will metal flow away from its intended direction, perhaps go into an adioining thicker part? Will a certain draft at one part pull down other parts? Will the roller have a difficult time with end thrust? Will a relatively thin part cool at an accelerated rate over the balance of the bar? Will there be any wire drawing? There are many other problems including the guides, and all those relating to balancing the work applied.

It is noticed that on some of the passes which Mr. Mohler so generously shows us, there is a build up of one part of the pass profile which on first impression appears to be over and above the relative proportions of the same part of the finished section. This illustrates two factors in a design. How to produce such a build-up at the strategic location in the pass system from a regularly shaped bar as coming from roughing or strand passes, and its exact amount to meet the demands of metal flow in later passes, and secondly, as the evolution of pass profiles continues to approach the finished section, how to keep all the parts in proportion to the finished section. In other words, a build-up is achieved from a regularly shaped starting bar and then rolled off.

Sometimes the planimeter answers a troublesome question on metal distribution or at least indexes the matter. Generally, however, it is most valuable in correction, or in evading, too little or too much work on one or the other sides of an arbitrarily drawn centerline.

Perhaps Mr. Mohler has best punctuated the frequently expressed fact that the profession of roll designing is an art. Successful production, of shapes particularly, can be had only through long experience from which to draw applications toward a new section or problem at hand. The influence of a good or poor mill roller is sometimes paramount once a workable design is demonstrated. A pass design lifted from one mill to another, per se, does not always work. A relatively slight change in roll diameters has its effects. Sometimes a given design works as desired when full sized rolls are used, when approaching or reaching discard diameter all sorts of "gremlins" appear.

It is not too easy a task to design the many complicated passes which customers have and continue to demand. Some approach contours which could be best produced by extrusion dies.

P. J. Frey: Mr. Mohler's method of approach is somewhat different from mine, but the reason for that is in his type of mill and stands available. We make our sash sections in six shaping passes as compared to the eight he uses. However, whether you use four, six, eight or even ten shaping passes, if you consistently roll true section with a minimum of mill trouble, your design is proper for bar being produced.

Burges A. LeMonte: I can cite a case where it is very

necessary. We have a straight-away mill at Aliquippa where the troughs leading from one stand to the next are only 18 in. wide. Therefore, the bars of unequal dimensions have to be proportioned exactly, or we could not deliver from one set into another. This is a very fast mill and it takes from 14 to 18 seconds from the time the piece leaves the furnace to the time it is on the cooling bed, and if we did not have the bar proportioned exactly, we would get no delivery on it at all.

William J. Wallace: The only thing I have to ask is what do you do in case of adhering metal on the side of your passes?

William H. Mohler: To answer Mr. Cameron's question, we do analyze the special shapes requested by the customer from the standpoint of a practical rolling proposition, and submit to them a drawing of their proposed section showing all of the necessary modifications required to make the section practical to roll.

Regarding Mr. Cameron's second question, we have rolled various special shapes of stainless steel with moderate success. However, we have found in some cases that special passes had to be designed because of the spreading tendency peculiar to stainless steel.

In answer to Mr. Wallace's question, I can say if he is alluding to stainless steel adhering to the side of passes, it certainly does, especially when there is only a few degrees taper on the side, and passes are too tight.

Mr. LeMonte has done a commendable job in designing rim sections on his 14-in. mill. It is considered a difficult task to roll unbalanced sections on a continuous mill. This becomes especially true with respect to a mill such as Mr. LeMonte's, as it is difficult to observe which way, if any, the bar is hooking. On a cross-country mill, the roller can usually stand close by and watch the bar enter and leave the stand, thereby observing defective delivery of the bar.

CURRENT AISE DISTRICT SECTION MEETINGS

BIRMINGHAM SECTION

Monday, February 27, 1950 — Dinner: 6:30 P.M.; Meeting: 8:00 P.M.

"Available Blast Furnace Refractories, Their Properties and Advantages," by Mervin A. Fay, Research Engineer, General Refractories Co., Philadelphia, Pa.

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Tuesday, March 14, 1950 — Dinner: 6:30 P.M.; Meeting: 8:00 P.M.

"Rolling Mills."

Buffalo Hotel, Washington and Swan Streets, Buffalo, N. Y.

CHICAGO SECTION

Tuesday, March 7, 1950 — Dinner: 6:15 P.M.; Meeting: 7:45 P.M.

"Cooling, Filtering and Humidity Control of Air to Mill Motors and Motor Rooms," by S. L. Jameson, Construction Engineering Division, General Electric Co., Schenectady, N. Y.

Phil Smidt's Restaurant, 1205 Calumet Ave., Hammond, Ind.

CLEVELAND SECTION

Monday, March 20, 1950 at Cleveland — Dinner: 6:30 P.M.; Meeting: 8:00 P.M.

Tuesday, March 21, 1950 at Youngstown — Dinner: 6:30 P.M.; Meeting 8:00 P.M.

"Why Not Standardize Low Voltage A-C Control for Steel Mills?" by E. H. Alexander, Manager, Commercial Engineering Division, General Electric Co., Schenectady, N. Y.

Cleveland: Cleveland Engineering Society, 2136 East 19th St., Cleveland, Ohio.

Youngstown: El Rio Club, Youngstown-Warren Rd., Route 422, Youngstown, Ohio.

DETROIT SECTION

Tuesday, March 14, 1950 — Dinner: 6:30 P.M.; Meeting: 8:00 P.M.

"The Mechanism of Material Handling and Facility Specifications," by C. Whiteford, Manager, Material Handling Engineering, Ford Motor Co., Dearborn, Mich.

"Refractories," by C. A. Brashears, District Representative, Harbison-Walker Refractories Co., Birmingham, Ala.

Horace Rackham Educational Memorial, 100 Farnsworth Ave., Detroit, Mich.

PHILADELPHIA SECTION

Saturday, March 4, 1950 — Dinner: 6:00 P.M.; Meeting: 7:00 P.M.

"A Report on Rolling Experiences," by Louis Moses, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Co., Sparrows Point, Md.

Engineers' Club, 1317 Spruce St., Philadelphia, Pa.

PITTSBURGH SECTION

Monday, March 13, 1950 — Dinner: 7:00 P.M.; Meeting: 8:00 P.M.

MAINTENANCE SYMPOSIUM

"Maintenance of Insulating Oils," by H. H. Marsh, Jr., General Superintendent Substations and Shops, Duquesne Light Co., Pittsburgh, Pa.

"Plastic Refractories for Furnace Construction and Maintenance," by K. J. Kettner, and R. M. Richardson, The Ramtite Co., Pittsburgh, Pa.

"Instrument Maintenance," by E. T. Mortson, Superintendent Power and Fuel, National Tube Co., McKeesport, Pa.

University Club, University Place, Pittsburgh, Pa.

STAINLESS STEEL —

Its Development and Use

. . . . the growth in the use of stainless is a tribute to the steel industry which developed a product unequalled in its corrosion and heat resisting, as well as aesthetic qualities . . . .

By V. W. WHITMER
Assistant Chief Metallurgist
Central Alloy District
Republic Steel Corp.
Massillon, Ohio

▲ EARLY work on the stainless steels occurred shortly after the turn of the century and the first patents were taken out both in England and the United States about 1912. These covered the straight chromium alloys containing about 12 per cent chrome and around 0.30 per cent carbon and were capable of being heat treated. A few years later patents were issued in Germany covering the chromium-nickel grades containing about 18 per cent chromium and 8 per cent nickel. These alloys were not magnetic and were not capable of hardening by heat treating. The purpose behind all these efforts was the development of alloys showing better corrosion and heat resisting properties than was offered by other commercial products at that time. These are still the two basic reasons for the use of the stainless steels today.

For the next ten years or so, these alloys were considered more or less in the research and development stage, and not until about 1924 was any serious effort made to produce and market them on a commercial basis for real practical use. For some time efforts were confined to the straight chrome grade with low carbon which showed comparatively good corrosion resistance in many cases but very soon ran into difficulty in fabrication. These alloys did not have as good ductility as soft steel nor were they readily weldable. These objections, along with greater stiffness in forming, developed considerable resistance to their acceptance. About 1927, 18-8 or the first of the chrome-nickel series, came into production and having very good ductility, excellent welding properties and being comparatively soft, was readily received by industry since it overcame the main objections presented by the straight chromium type. The advantages presented by these alloys, particularly in connection with the chemical and food processing industries, were readily apparent but the actual adoption

Figure 1 — These roll grinding machines are used for grinding the work rolls for 54 and 66-in. cold reducing and finishing mills.

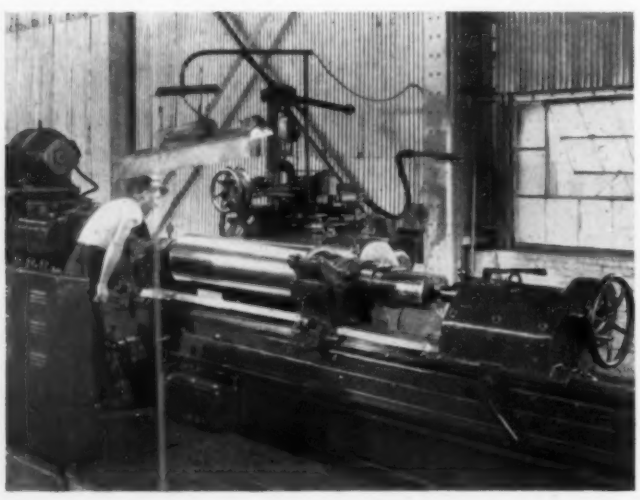


Figure 2 — View shows 54 and 66-in. cold reducing 4-high reversing mill.

and use in these industries was slow though steady.

The first real impetus came from the chemical industry when in 1926 a large chemical company installed equipment for the production of nitric acid in which the towers, piping, etc., were constructed of 16 per cent straight chrome plates and sheets. Since welding was not too dependable at that time, the entire installation was riveted. This required in excess of 100 tons of stainless in various forms which at that time was quite a sizable amount. The excellent resistance of stainless steel to nitric acid made such an installation, fabricated from light plates, possible.

The second step in the expanding use of stainless came from the automotive industry about 1929 when one company adopted 18-8 for their radiator shells. This saved the expense of chromium plating lines and established stainless as an excellent material for trim in the automotive industry. A few years later the type of stainless for this application was changed in general from the chrome-nickel to the straight chromium grade which is largely used today.

The next milestone, so to speak, was presented by the architectural field when, about 1930, 18-8 polished sheets were installed on both the Chrysler and Empire State Buildings in New York City. It was used for trim on both outside and interior applications. About this same time the petroleum refining industry recognized the high creep strength properties of the chrome-nickel grades and began using it in their high temperature and high pressure cracking stills.

These two basic types, the straight chrome and the chrome-nickel grades, were pretty well established for many applications by the time of the business recession or depression in the early '30's. Many manufacturers in an effort to help their sales, redesigned their product, using stainless steel with the result that production increased materially every year during that period. Such increased activity and broad applications were bound to find numerous applications where the existing two types would not be satisfactory for the purpose intended. The additional requirements might be in the form of still higher corrosion resistance, better machinability, increased heat resistance, etc., necessitating a modified or improved product, if it were to be successfully applied for the expanded operations. This started a development in which the number of stainless types and modifications increased from two or three up to thirty or forty different grades and is still continuing at the present time.

The straight chromium stainless grades contain essentially chromium in amounts in excess of 10 per cent chromium with either high or low carbon content and other alloys in small quantities to develop specific properties. As the chromium content is increased, the heat resisting properties are enhanced and hardenability characteristics are decreased except with material increases in carbon. They are all ferritic or magnetic, and have a low coefficient of expansion, fair ductility and welding characteristics and fair machinability. They can be hot forged or hammered into most any desirable shape and can be cold worked, deep drawn or spun, into most any desired article quite similar to common steel. Additions of aluminum in small quantities materially reduce hardenability on welding. Small amounts of nickel help hardenability. Additions of sulphur or selenium improve machinability and carry them almost into the realm of screw machine stock.

The chromium-nickel grades of stainless contain essentially 16 per cent or more chromium with 6 per cent or more nickel, with or without other alloys to obtain specific properties. The most common of these types contains about 18 per cent chromium with 9 per cent nickel and is known commercially as 18-8 or AISI Type 302. These alloys are non-magnetic and cannot be hardened by heat treating. They have a high coefficient of expansion, and are quite soft and ductile and readily deep drawn or formed into various shapes, but are subject to more rapid cold working than are the straight chrome types. They can be hot worked, forged, rolled, etc., and are particularly well suited to welding operations since the welds are quite soft and ductile in the as welded condition. The 18-8 grade is most commonly used in sheet form and is well adapted to a large range of applications. Additions of about 3 per cent molybdenum to 18-8 materially improve corrosion resistance, particularly with respect to mineral acids and some salt

Figure 3 — Entry side of 4-high cold reducing mill.

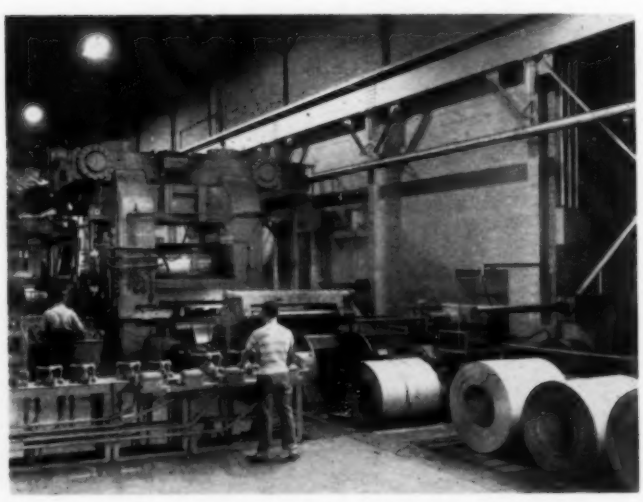


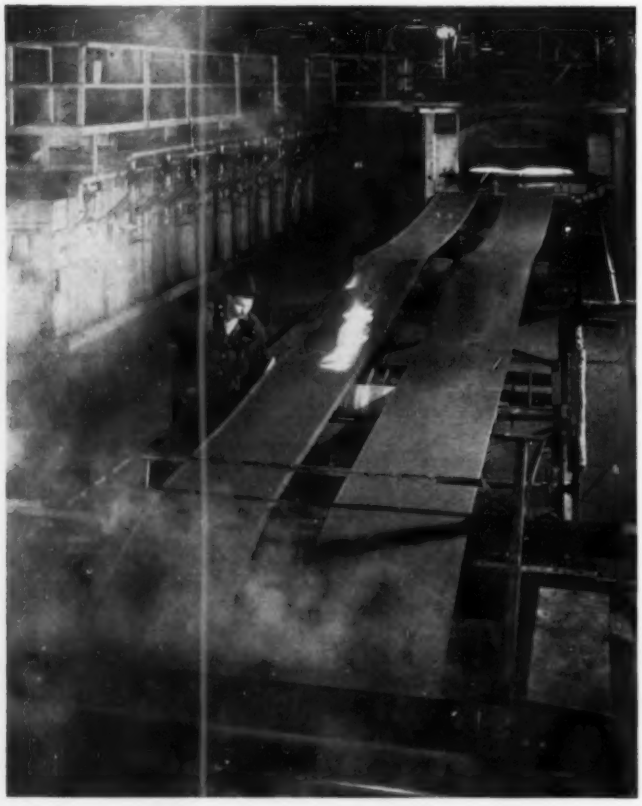
Figure 4 — General view shows compact layout of 34, 28 and 20-in. 4-high cold reducing mill with 18-in., 2-stand tandem mill in background.

solutions. About 2 per cent silicon alloyed with 18-8 will enable the alloy to withstand about 200 F higher temperature, and greatly reduce the tendency toward flaking of the scale on cooling. Columbium or titanium additions to 18-8 with low carbon have a stabilizing effect tending to retain the carbon in solution when the alloy is heated in the 900-1600 F range, and reduces the ill effects that might occur if carbides were precipitated in the grain boundaries. Eighteen-eight is very soft and gummy for any machining operations. Additions of sulphur or selenium either with or without high phosphorus, tends to dry up the product, offering very much better machinability and improved surfaces after the finishing cut. Higher amounts of chromium and nickel up to the order of 25 per cent chromium with 20 per cent nickel, either with or without the other alloy additions noted previously, will very greatly enhance the scale resisting properties at the higher temperatures.

The architectural field has used stainless, particularly the 18-8 type, to very good advantage. Polished surfaces are preferred, and the design should be such as to present adequate facilities for washing and draining. There are some places, particularly along the seacoast, where salt water corrosion is encountered, and addition of 3 per cent molybdenum to the 18-8 should be used. This same is true for insect screening in the tropics and for areas subject to heavy soot or smoke. In any event, the design should permit ready washing and draining under atmospheric conditions.

The chemical industry was about the first to recognize the possibilities and advantages of stainless from an equipment standpoint. It is particularly advantageous for handling nitric acid in both production and shipping as well as storage. It is also well suited for handling the organic or fatty acids and their compounds, but is not generally recommended for the mineral acids or halogen acids or salts except in specific instances.

Figure 5 — Strip is shown leaving process annealing furnace and entering continuous pickling tanks.



The paper industry, notably in the production of sulphite pulp, has profited through the use of 18-8 containing about 3 per cent molybdenum. This alloy, along with one other containing higher amounts of chromium, nickel and molybdenum have made possible the circulation of the cooking acids in sulphite digesters, permitting better agitation and a more uniform product as well as increased production. Regular 18-8 has worked out well in the sulphate process, as well as in other operations beyond the sulphite pulp production in eliminating corrosion with its attendant increased cost and difficulties encountered with rust stains when using ordinary iron products.

Stainless has served well the rubber industry in the production of synthetic materials to replace natural rubber. This is in the form of tanks, reaction chambers, heat exchangers, bubble caps, trays, etc.

Shipping has always been a problem in the chemical industry. Glass carboys were generally used for the more corrosive acids, and steel drums where corrosion was not much of a factor. Stainless steel drums of any one of several analyses have replaced to a large extent the glass carboys permitting much less dead weight per unit and materially lower transportation charges. These are used for shipping nitric, acetic and phosphoric acids as well as numerous other compounds.

The higher chromium and chromium-nickel alloys show very good heat resistance in temperature ranges as high as 2000 F, and have made possible radiant tube heating furnaces as well as increased life and improved economy in other parts such as annealing covers, hangers, rollers, etc., where a minimum of scale is of prime importance.

Hospital equipment, even to complete floors, walls and ceilings in operating rooms along with auxiliary equipment and surgical instruments have been practically standardized on stainless. Bone plates, screws and other items for bone surgery are made of 18-8 with 3 per cent molybdenum as it is not affected by blood or body fluids and is used for either temporary or permanent bone repairs.

Stainless probably enjoys its broadest use in the food handling industries. In this group the dairy industry has practically standardized on stainless for equipment such as pasteurizers, holding tanks, cooling coils, ice cream equipment, etc., wherever the dairy products are in contact with the metal itself. It is unaffected by practically all the dairy products and is extremely easy and simple to maintain clean and sanitary. This is of vital importance, particularly from an economic standpoint, as well as quality of product, as the health laws throughout the country are becoming more and more strict. The grade generally employed is 18-8 though some pieces of equipment for better corrosion resistance are fabricated from 18-8 SMo. Between these two grades they cover the entire field.

The meat packing industry prefers stainless for con-

veyors, tables, cooking or other equipment used in the processing of meat prior to final packaging. Here again, ease in cleaning, sanitation and low maintenance costs are the real advantages to be gained. Some 18-8 SMo is used in the fatty acids processing equipment, but generally 18-8 is satisfactory.

The brewery industry, since it took a new lease on life during the '30's, has been using more and more stainless in processing equipment. Previously, this was practically all copper which required considerable more upkeep. Stainless is much easier to keep clean and has materially reduced maintenance costs. It is used for kettles, tanks, coolers, bottling equipment and shipping barrels. It is particularly advantageous in shipping kegs as it is much lighter than the conventional wood barrel and does not require repitching before filling.

The most commonly used stainless in the food industry is very likely the average kitchen utensils in the form of pots and pans and other items found in individual homes. These, for the most part, are fabricated from 18-8 stainless though some items may be at times the straight 18 per cent chromium. They may take several forms such as solid stainless all over as represented by the first utensils produced. Later copper was plated across the bottom and part way up the sides to obtain improved heat transfer. Similarly, a clad product with soft steel in the center, and even copper at times, with stainless on both exposed surfaces has been used to obtain a similar result.

The petroleum industry, particularly in the refining division, early took advantage of the high creep strength of 18-8 stainless for use in still tubes in high temperature and pressure cracking stills. Its corrosion resistance was more than ample to withstand any attack from the sour crudes and worked out very well in this respect. Both the 18-8 and 18-8 molybdenum chrome-nickel grades, as well as the straight chromium type containing about 12 per cent chromium, are used today in different processes. The 12 per cent chromium is well adapted to tank linings as well as bubble caps and trays in the fractionating towers. Stainless valves, piping and fittings have also been used to good advantage in this industry.

Figure 6 — Thorough inspection is required before shipping. View shows inspection benches for inspection of final cold rolled slit strip before shipping.

The transportation industry, where savings in weight are always of economic value, has profited by stainless in several ways. In the automobile field the straight chromium containing 17 per cent chromium is most commonly used. This is primarily for trim or decorative effect though some bar stock is used for studs, pump shafts and carburetor parts on the engine proper. The decorative trim requires large quantities of stainless, and after polishing is required to match up very closely in color any other chromium plated parts. The truck and trailer field used considerable high tensile cold rolled 18-8 stainless in the construction of bodies. Here the reduction of weight due to the higher strength of the cold rolled strip, along with low maintenance cost, is the deciding factor in the use of stainless.

The railroads also use stainless in the high tensile form as a material of construction in an effort to reduce dead weight and increase pay load. Here stainless can be used, either as the entire material of construction including the center sill, or it can be applied more as a sheeting over the outside. In this case, the load carrying materials are generally of a low alloy or carbon steel. It is also used extensively for interior trim, and almost universally for dining car applications. Here of course the reason is basically food handling and sanitary requirements.

The aircraft industry has made good use of stainless, particularly the titanium and columbium bearing 18-8 stabilized grades, for high temperature applications such as exhaust stacks, collector rings and other parts subject to elevated temperatures. Similar items as fire walls, flaps and cowling have also been stainless for moderate high temperature work and safety. With the advent of jet engines, much more stainless will be required of these and other types containing higher alloys for higher temperature resistance as well as increased strength at the elevated temperatures. Stainless may also be used to advantage on structural parts and surface coverings on some planes, as the speeds are materially increased and higher frictional temperatures encountered.

Over the past 25 years, since stainless has been in commercial production, it has enjoyed a steady increase in useful applications. Its advantages were recognized early in nearly all fields where economy and special requirements were necessary. There are very few actually new applications for stainless today, even though production has steadily increased. It is only natural to assume this demand will continue to increase in the future as it has in the past in those fields requiring corrosion, heat resistance, or some other specific property, and where economy of operation and maintenance is of prime importance.

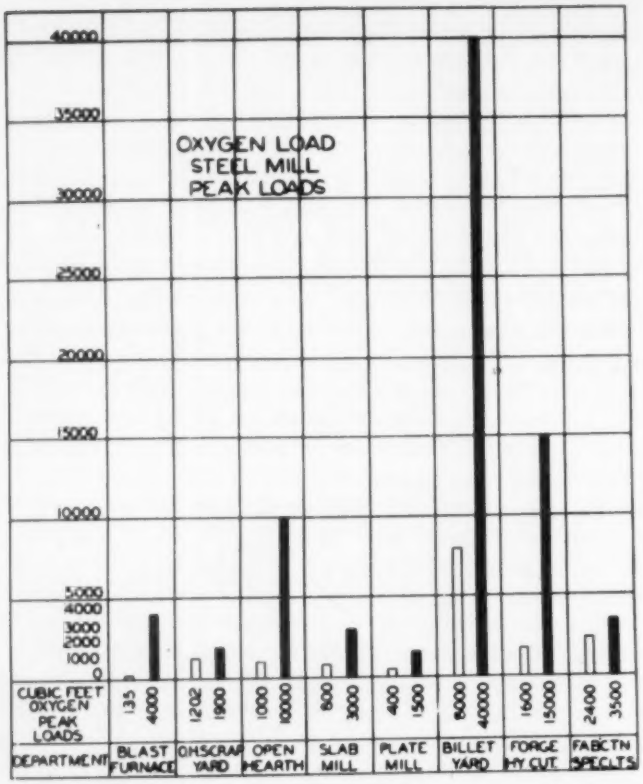
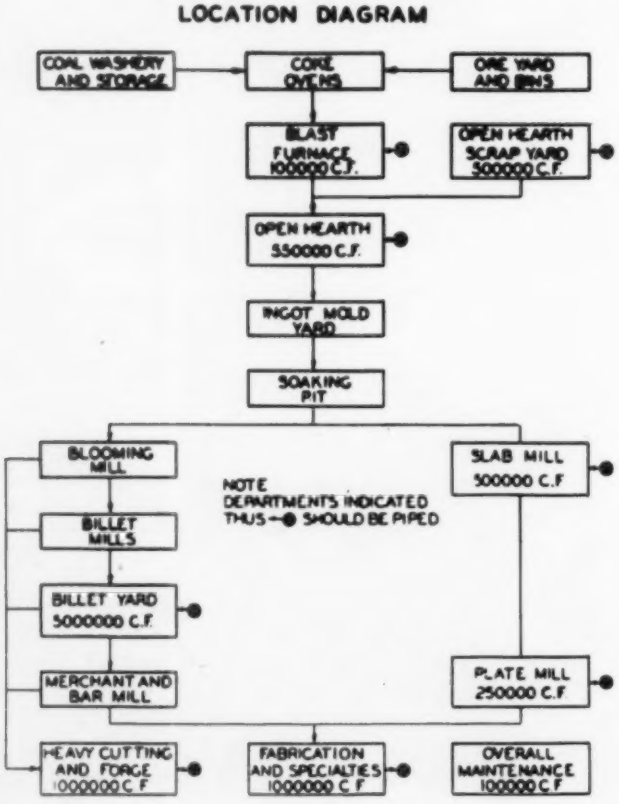


Figure 1 — Complete analytical breakdowns such as this are a requisite for logical planning of gas supply systems. Such data, corrected to include potential maintenance loads, permit sound evaluation for pipe line purposes.

Figure 2 — Chart shows sections of the plant, based on data shown in Figure 1, with departments and areas which require pipe line service differentiated from those which can be served by portable supply methods.



STEEL PLANT

. . . welding, cutting, and burning equipment constitute some of the most versatile and efficient tools in the hands of steel plant maintenance men . . . .

▲ THERE can be very little doubt in the mind of anyone connected with the steel industry that plant maintenance is of prime importance to a smooth-running, top-producing steel mill. However, to a casual observer touring a rolling mill, open hearth plant, or blast furnace department, little or nothing is apparent of the work required to keep up the visible pattern of uninterrupted production, for it is largely hidden behind the scenes.

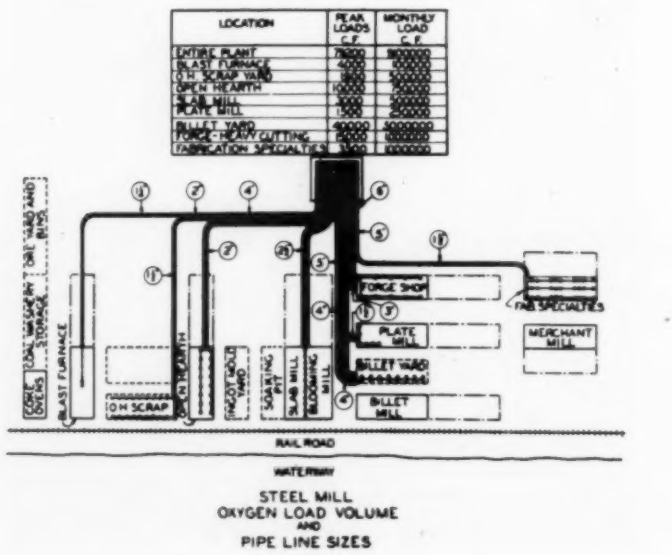
There is nothing glamorous about the maintenance and repair work which supports the smooth efforts of these various units, but without such work, wear, erosion, heat, shock and other kinds of destructive forces would soon take a heavy toll of production. That the mills keep rolling; that the furnaces continue to make ongrade steel and iron at a reasonable cost is due largely to modern efficient maintenance methods.

Such modern methods are based on three important fundamentals:

1. Effective planning and organization of plant personnel and facilities.
2. Effective and economical use of the most modern tools and processes.
3. Work properly engineered from the safety standpoint.

These three fundamentals are strongly interdependent. Their actual implementation depends largely upon the operations involved, their number, size and nature.

Figure 3 — Diagram of entire plant, with directions, sizes and scope of pipe line system branches worked out in accord with analytical data and estimates of future needs.



MAINTENANCE

By S. D. BAUMER*
Manager, Technical Sales Div.
Air Reduction Sales Co.
New York, N. Y.

While these details may vary, certain general considerations, common only to the steel industry, form a universal base for effective steel plant maintenance.

These considerations are:

1. Steel mill equipment works at high production levels, often continuously, on closely integrated schedules.
2. Equipment is heavy and massive, yet subject to such wear and tear that maintenance is a repetitive, demanding job.
3. Relation of costs to profits is such that every operation, maintenance included, must be economically justifiable—efficient and reliable.
4. The changing, modifying, and improving of equipment is a constant challenge in steel plant operations.

To meet such requirements, steel plant maintenance men have long relied on the help of various specialized industries to provide the tools and methods to do the job. Of outstanding importance in this field is the flame-cutting and welding industry. Oxyacetylene cutting, oxyacetylene and arc welding, and numerous related processes, furthered by a steady progress in new methods and equipment, are of vital importance to the speed, efficiency and safety of the modern maintenance department.

As one result of this progress, the modern tools and methods for cutting and welding provide exceptional variety and versatility. If full benefit is to be reaped from this, it is absolutely essential that effective plan-

Figure 5 — For field work, a successful and economical means of large-volume portable oxygen supply is the trailer system with a high-capacity portable manifold and regulator unit, and a portable manifold of cylinder acetylene.

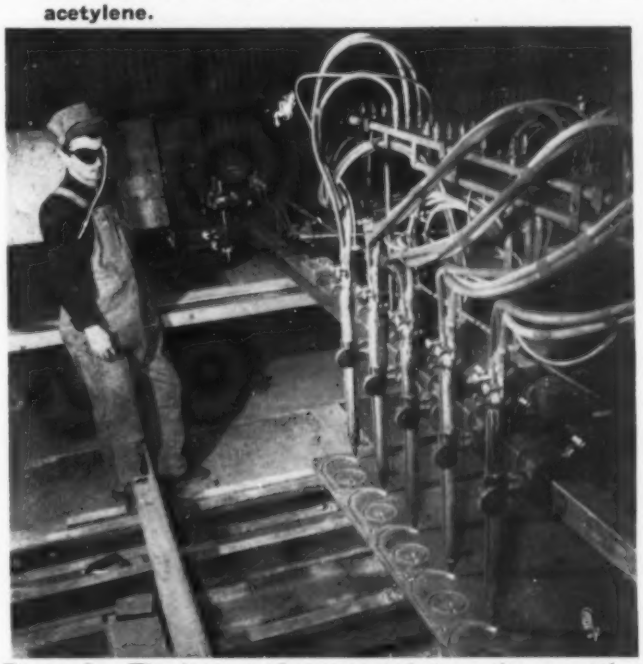


Figure 6 — The largest of pantograph type shape-cutting machines, here cutting both inner and outer contours, five at a time, is typical of the shape-cutting units which are the basic flame-cutting tool of the steel mill maintenance department.

Figure 7 — The electronic tracer, used on the machine shown in Figure 6, provides maximum economy and versatility in tracing methods for flame shape cutting. A beam of light follows the sharp contrast of black-and-white lines on a drawn or cut-out template. Intricacy hardly possible by other tracing means is available with this device.

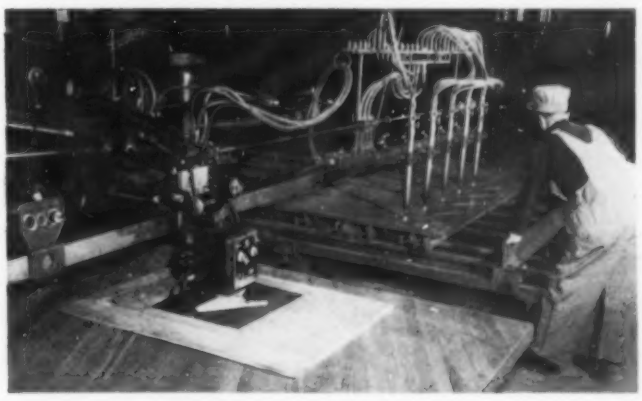
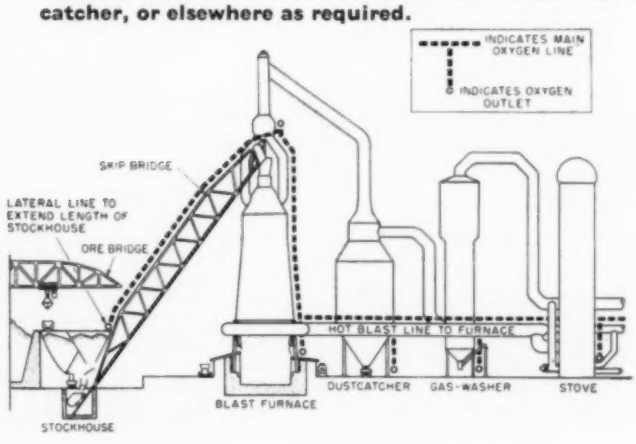


Figure 4 — Special purpose pipe line installations are illustrated by this set-up, used for blast-furnace rebuilding jobs. Permanent or temporary, the line is organized to provide ample supplies of oxygen wherever needed — up the height of the shell, out to the stock house, along the skip hoist, at the stoves and dust-catcher, or elsewhere as required.



* Paper read by John H. Berryman, Air Reduction Sales Co., New York, N. Y.

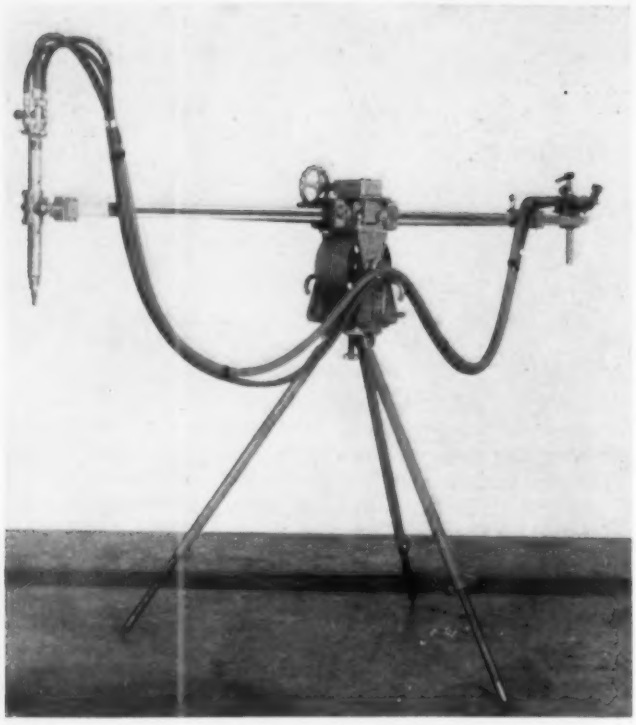


Figure 8 — A heavy duty, universal, positioning rig for special steel mill cutting work. The long "reach" of the bar and the universal positioning provided by the machinegun mount adapt it for many otherwise hard-to-reach cutting jobs.

ning and organization; sound over-all knowhow; top-notch supervision; and good workers, properly trained, be provided for maintenance work. The right man and the right tools, properly placed, can and will save many hours of costly delays in all forms of mill maintenance. This, ultimately, means more profit to the individual unit involved.

For such an objective in welding and cutting operations, probably one of the most important items to consider, not only in maintenance but also in production, is the planning of the oxyacetylene supply system.

Such planning starts with a realistic analysis of the plant and a survey of the existing and predictable requirements (Figures 1, 2 and 3). This is not a one-man job, but a step-by-step, shop-by-shop study through the eyes of the men as well as the management, who will use these commodities to determine just what should be provided. Where anything approaching guesswork is required, as it may well be, the wise procedure would be to consider emergencies as well as progress inevitable. It is definitely less costly to be prepared for added loads—and when the load is required for a breakdown, less costly to be ready than to sweat out serious trouble for the lack of a few hundred dollars in pipe lines and valves.

Where pipe lines are found, as they may, to be just getting by, it could be economically sound to continue with them, even with new equipment, if the supply system can handle the load. It should be remembered that all such facilities which must be strained, pushed, and overloaded are drawbacks to speed, efficiency, effectiveness and safety.

In studying these facilities and correcting their lacks and faults, the possible need for special equipment or auxiliaries to standard equipment, should be carefully considered. Not every mill will need or want the same equipment, but basically they will need the same types.

For example, one case may require burning out a blast furnace salamander. Another may call for burning out an open hearth spill. The basic problem in each case is the same, requiring similar equipment, and similarly abnormal supplies of gases. If the supply source and distribution system do not provide sufficient gas, and the proper equipment is not promptly available, the job is slowed down and the loss of production can go out of sight.

Supply problems for such jobs can be solved two ways. The basic pipe line and supply system to take care of such emergencies (Figure 4) can be designed in advance as a permanent part of the blast furnace and open hearth systems in large plants, or special facilities can be planned to be set up in advance for rebuilding operations.

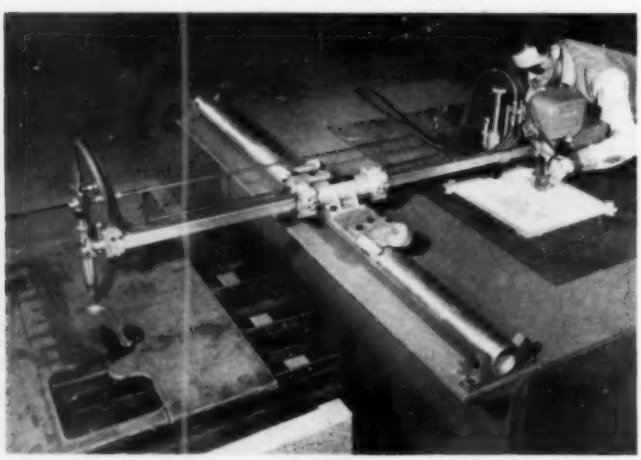
Where this type of reasoning is not feasible, temporary large-quantity supplies of gas can be furnished from trailers and portable manifolds (Figure 5), properly equipped to handle large loads in short periods of time. This procedure has proven very economical in a number of cases.

One very important consideration—and a most vital one to our way of thinking—is the safety of any and every one of these installations, which is often largely dependent upon the types and arrangement of equipment using the gases carried in the lines.

Overloaded or undersize equipment is risky in itself and should not be tolerated. Even worse is equipment which has been jury-rigged with no thought of safety. Any set-up which ties up too much of the attention and faculties of the operator in its operation increases the likelihood of accident, as well as causing slower and poorer work.

The establishment of pipe line and operating safety standards for oxyacetylene work, and procedures for the basic operations in steel mill maintenance is an obvious objective. Since much of the work is repeated, standard procedures can be set up and the supervision in these cases cut to a minimum. Such basic plans of operation take considerable initial time and effort to

Figure 9 — Portable, compact, lightweight new shape-cutting machine, designed for on-the-spot cutting work, provides the latest developments in convenience and flexibility for a variety of jobs.



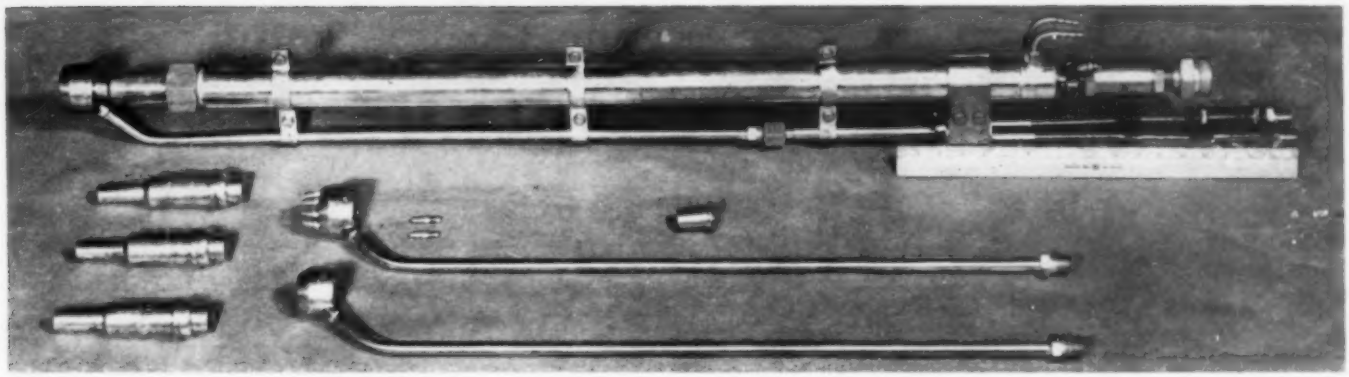


Figure 10 — Heavy duty machine cutting torch, with complement of accessories and tips, designed to handle the heaviest types of cutting in steel mill work.

prepare, but they save many delays by the resulting assured preparedness for minimum difficulties on routine work.

Naturally, all this planning will be affected to some extent by the type of organization set up to do the actual work. In most large mills, the logical and healthy trend is to a central maintenance organization. In this system the management of the maintenance department has under direct control the major part of the force, equipment, and facilities, in a central pool of equipment and men for both shop and field work. In conjunction with this group, each major subdivision of the plant will have one or two or three or four "captive" welders and burners, with sufficient equipment located in the division shop to handle minor routine work. These men, however, belong to and are under the supervision of the central organization as far as procedures, quality, etc., are concerned. In this system, the central maintenance shop has not only facilities for welding and cutting, but for fabrication, machining, and other operations in conjunction with welding and cutting, so that a completely renewed part of standardized quality and workmanship will be available. As a result, maintenance operations can be carried on with a lower inventory of equipment and supplies, with less manpower more efficiently occupied, and with more reliable results. Further, since the operation is under one close-working management, scheduling and time can be better worked out and governed, so that a smaller inventory of spare parts for the plant is possible without increasing the risk of shutdowns.

For the smaller plant, where the overhead of a large central maintenance shop is not justified, two methods are available. One is the use of more fully developed departmental maintenance crews, under a centralized management, so organized that interchanges of men, work, and equipment can be readily made, as required, by the central authority. The other method, far more desirable when feasible, is to use the basic centralized system, and replace the central maintenance shop with the services of a well equipped commercial shop, working in close harmony with the maintenance welding and cutting supervisors.

In either case, the maintenance welding and cutting

Figure 11 — Huge, but well-balanced, this heavy duty hand torch is designed primarily for cutting very heavy sections, such as scrap or demolition work, which are not suitable for machine applications.

Figure 12 — One of the most dramatic accomplishments of steel maintenance men during the war was the rapid rebuilding and restoration to production of blast furnaces, which was made possible largely by skillful planning based on the use of welding and cutting. These operators are welding sections of a new flame-cut tuyere jacket.

operations cannot very well be divorced from other crafts which must cooperate with them for all around effectiveness. Construction men, furnace crews, machinists, and millwright crews must all at one time or another work together.

The best of organization and planning, the best of supply systems, are only as effective as the tools—the equipment—provided for the actual jobs. This is particularly important in welding and cutting work, where careful matching of the equipment to the job's requirements can make a great difference in efficiency, speed, and safety of the operation.

It is only good economy to back up the maintenance department with the best equipment that can be obtained. A maintenance staff equipped with hand-me-downs, with obsolete tools, with outdated and underpowered machines, is half-beaten before it gets started on any but the most rudimentary jobs. There is virtually nothing, however, from a complete furnace to a bracket which cannot be turned out by a modern maintenance staff, fully equipped with the best of modern tools, by cutting and welded fabrication within the requirements of mill schedules.

In the fabrication of replacement parts by gas cutting and welding, which has been standard steel mill practice for many years, the basic tool is the large-area stationary shape-cutting machine. Such a machine, as illustrated in Figure 6, is one of the most versatile units available for maintenance work on an around-the-clock basis when required. The cutting area is 12 ft wide by any length desired, and the machine can carry up to 12 torches at once. Such flexibility and capacity mean savings of many important hours.

With the machine as illustrated, however, there is an even greater degree of usefulness and efficiency because of the electronic tracer with which it is equipped (Figure 7). This device, operating on the principle of the "electric eye," traces any pattern required within the dimensional scope of the machine, using a template made of paper, either a cut-out silhouette or a black and white drawing. The ease and speed with which templates can be prepared, even for one-shot operations, are advantageous over older equipment using either hand guided tracing, track guided spindles, or a magnetic spindle against a machined steel cam. Jobs on record today claim savings of 30 to 40 per cent over previous methods of cutting out steel mill parts.

Figure 13 — Repairing of such parts as this mill housing by welding and braze-welding, although well established procedure, often tax the ingenuity and skill of maintenance men to the limit.

Figure 14 — Such expensive and specialized parts as this copper blast furnace cooler are routine repair jobs for modern maintenance crews. Torch welding with electrolytic copper rod will salvage this part at very reasonable cost, and quickly.

While that machine is only one of several types of stationary shape cutting units, its capabilities have made it more or less standard in its category for steel mill work. There are many other cutting machines, of portable types, that are used regularly where ease of handling for on-the-job cutting is necessary.

A newly developed machine for such requirements, illustrated in Figure 8, can be operated in practically any position required. It works on its tripod base rather like a machine gun, and in case of emergency, the machine can be broken down into a separate unit using the bar, rack and slide-box to make vertical and horizontal cuts such as may be necessary in the replacement of worn or buckled blast furnace shells. A motor may be attached for power drive on the rack when required.

The newest type of shape-cutting machine is a compact, portable unit designed for quick and easy transport from stock pile to shop floor to field, illustrated in Figure 9. This machine can be compactly packed into a wooden box for handling from place to place by two men, and can be set up and working in a matter of minutes.

Obviously, any cutting machine must be equipped with the necessary auxiliaries (Figure 10), torches, tips, etc., to cut within their range, and a properly outfitted combination of machines will readily accommodate the entire scope of steel mill maintenance thicknesses, which has been found to range from $\frac{1}{8}$ to 72 in.

Naturally, it is often found that cutting jobs are not practical work for machine operation. For such jobs, which are seldom if ever shape-cutting or precision-cutting operations, special hand equipment has been

designed (Figure 11) which can be of tremendous value to the maintenance department. Such hand torches often do in minutes what other more tedious methods would require hours to complete, and their range of thickness is surprisingly great.

It is worth reiterating at this point that although this equipment may not all be used as a steady diet, the advantages of keeping such units available are considerable. It is the rule of the right tool in the right hands at the right time, a cardinal principle of good maintenance planning. The fact that such units are available at crucial periods can save many sleepless nights for the maintenance crews.

The same type of approach results in the same preparedness and confidence with such elements of maintenance welding as electrodes and other supplies. An ample, well-balanced inventory of electrodes need not be large or particularly costly if it is skillfully planned to meet logical needs. A few pounds of a special rod in stock at the right time may be worth hundreds or thousands of dollars in a single emergency repair. Modern steel mill maintenance requires such planning and foresight if it is to do its job effectively.

The casual observer, when maintenance is mentioned, is likely to think first of such dramatic and magnificent feats as the record-time rebuilding of a blast furnace (Figure 12). However, though they are far less dramatic, even more important to the steady efficiency of operations are the day-in, day-out jobs of the maintenance department on such equipment as rolling mills, cranes, transportation equipment, and other machinery of the plant.

This maintenance work falls into two categories, as far as welding, cutting, or any other operation is concerned. The first is the emergency type of repair, as when a mill housing breaks or any other "one-of-a-kind" part comes up for repair. The second is the constantly recurring repair of such parts as coupling boxes, guides, rolls, buckets, chutes, and other parts used in large numbers and under such severe conditions as to require frequent replacement.

The successes of cutting and welding in the first type of repair (Figures 13 and 14) have been frequently and thoroughly documented for many years. Welding of broken engine bases, frames, mill housings, presses and other such heavy castings are often the kind of job that tests a maintenance organization—its skill and knowhow and patience—to the limit. The successful completion of hundreds of such repairs is valid evidence that they can be, and are, well within the capabilities of a skilled, well-equipped maintenance crew.

Figure 15 — Cold strip mill guide, as welded. Deposition of new metal, followed by machine finishing, will return the part ready for service as good as new. Other, similar jobs, by means of hard facing may be returned to service with greatly improved qualities and lengthened service life.

Figure 16 — Arcwelded fabrication of flame-cut parts provides a means both of replacing units, and remodeling them to provide better service life or greater utility. This operator is working on an open-hearth furnace door.

The second type of repair, which is largely a central-shop operation in modern systems, is probably the largest single maintenance task in the plant, and certainly the largest single use of welding. It is here (Figure 15) that worn parts are restored. They may be rebuilt to size. They may be hard-faced to ward off further wear. They may be soft-faced to prevent wearing of the work or of a mating part. They may be reinforced, or lengthened, or otherwise modified if required. Many repairs are actually improvements, many others consist of completely, or almost completely, new parts (Figures 16 and 17). All of them are centered around either welded fabrication or weld-deposited new metal.

It is in such operations that availability of the correct equipment, electrodes, and supplies; of the correct personnel, and the functioning of top-notch supervision become of greatest importance. Supervision must operate both to control the cost, efficiency and quality of the work, and to schedule and channel shop production to keep the necessary backlog of spare parts ready when they are needed. The supervisors must have reliable, capable operators to carry out the work according to specifications for each different job. The operators must have the necessary equipment and supplies with which to work. Without all this, properly planned and organized, the work will become slipshod, inefficient and unsatisfactory. With it, results, costs, and efficiency will all be highly gratifying.

The same principles underlie the success of all phases of steel mill maintenance. Fundamentally, they can be summed up as the application of production thinking and production standards to maintenance work. This is a well-established trend of the past few years, and has proved a very worthwhile approach. Centralized maintenance methods, extended use of better preventive maintenance, and rapid adoption of new and improved techniques and equipment have characterized recent developments in maintenance operations.

Today, as we move through a changing economic pattern, it would be unfortunate to see this trend die out, just when it is most urgently needed. The next few

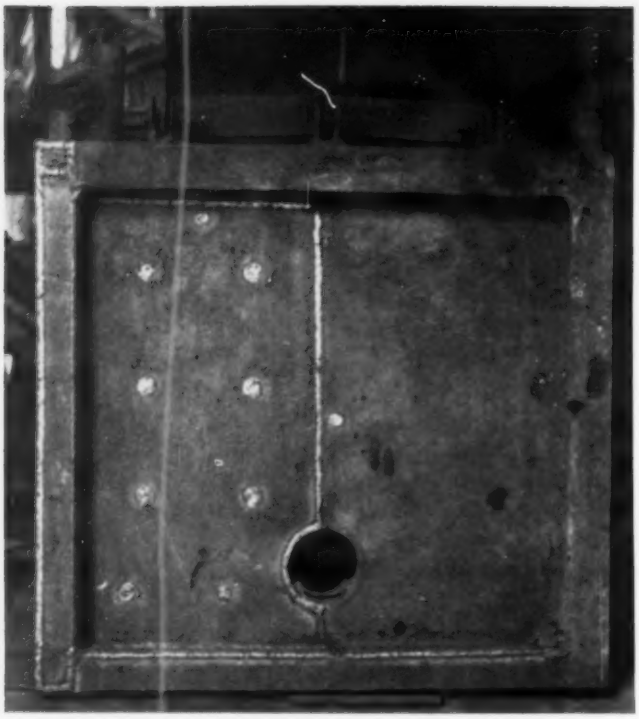


Figure 17 — Completed door for open-hearth furnace, gas-cut and weld-fabricated in the maintenance shop. The all around flexibility of this type of fabrication is of invaluable importance to modern steel plant maintenance practices.

years will see the introduction of still more new techniques and facilities, still further improvements in methods, and steadily increasing knowhow among maintenance men. If the trend of recent years continues, we are bound to see some remarkable advances in the near future.

DISCUSSION

PRESENTED BY

L. J. GOULD, Chief Engineer of Construction, Bethlehem Steel Co., Bethlehem, Pa.

L. P. ELLY, Welding Supervisor, Bethlehem Steel Co., Bethlehem, Pa.

L. J. Gould: Welding and burning are apt to become something of a religion or a way of life. People talk of Welding with a capital "W" and forget that it is only one more means of joining two objects together and that sometimes the methods of burning and welding are not the best way to perform the task in hand.

Twenty years ago most of us were aware that it was necessary to place some restrictions on the use of burning. You still see occasions where good material is destroyed by burning, when a little more care in disassembling would save considerable money. This is particularly true of large bolts which the millwright will find it much easier to destroy than to remove. We are constantly told of operations where it is proposed to burn off objects that could just as easily be sheared. The persons suggesting burning frequently forget that where shearing is possible it is usually much cheaper and that in general burning is not cheap.

It is a very common attempt to replace forgings and castings with materials whose greatest virtue is that they can easily be welded. Not too long ago we heard of the replacement of a forged alloy draw bench chain with a welded structure which reduced the manufacturing cost 60 per cent. We understand that the chain made two passes around the sheave before it was replaced. This does not mean that there are not occasions when welding will produce the best solution, but merely to point out that this is not always the case.

It seems to me that the author implies that the rest of the maintenance forces are subsidiary to the burning and cutting organization and should cooperate with it. I suggest again that no matter how important burning and welding are, they are still just one of the methods and subsidiary to the general problems of maintenance.

Certainly the welding equipment manufacturers have done their best to expand the use of their equipment and processes, and have given us much better tools than we had some years back. We are always interested in seeing their new ideas as set forth in this paper and believe they deserve a great deal of credit for the tools they have produced. One group of special tools which they have not mentioned in this paper is the long torch. In the past, in many of our plants, we have made torches twelve to fourteen feet long simply to keep the operator away from the result of his burning.

L. P. Elly: The author points out the advisability when designing oxygen and acetylene pipe line distributions of considering emergencies and future expansion inevitable. This point should not be taken lightly as our own experience has indicated. Uses and locations of gas cutting and welding in a steel mill are constantly changing. An oversized initial installation with properly located shutoff valves for future connections will justify its initial expense many times over.

As pointed out so clearly in this paper, in order to realize the maximum return from the welding and cutting arts in the maintenance field, it is necessary to provide the best equipment that is available. However, the maintenance of this equipment is very nearly as important as its existence. In maintaining welding and cutting equipment, nothing is as satisfactory as a central repair and maintenance organization, stocked with both spare parts and equipment, and staffed with skilled and experienced specialists. Normal procedure is to overhaul and recondition equipment in the central shop, replacing it with spare units. This provides reliability of equipment at a minimum effort and expense. Spare parts inventories are reduced, repair work is done better and faster, and the experience and skill for such work is concentrated where it can do the most good.

Present day material and labor costs are high. Such an economic picture demands the successful reclamation rather than replacement of defective equipment. Recognition and use of gas cutting and welding in maintenance becomes absolutely necessary to meet this demand.

Apprentice Training -

. . . . apprentice training is a difficult job which requires careful planning and scheduling, particularly in a steel plant where the men must be trained for non-repetitive maintenance operations . . . .

Tradesmen for Tomorrow

By GEORGE M. KENNEDY
Assistant to Director
Education and Training
Carnegie-Illinois Steel Corp.
Pittsburgh, Pa.

▲ THE "tradesmen for tomorrow" are for the most part ex-servicemen like John Doe, survivor of the Bataan death march, Sam Jones, who lost his left arm and now wears a hook, and Bill Brown who survived all the engagements of the aircraft carrier Essex. The apprentices for the tradesmen of yesterday were scarcely more than boys and their apprenticeship for the most part, was not a well organized training program. Each apprentice was assigned to a journeyman whose job it was to teach him the trade. The effectiveness of his training was totally dependent upon the fatherly instinct of the journeyman to treat and teach him as he would his own son.

Many industries operated this type of apprentice training program during the early part of the twentieth century. Conditions did not change noticeably until after World War I when national and state legislation was adopted granting federal and state monies for the encouragement and administration of vocational education, which in turn brought an upsurge in apprentice training. These improved programs remained in effect until the early thirties when an overburdened labor market discouraged any thought of training for tomorrow. Better economic conditions and a predominately aged group of tradesmen again brought about an upsurge of apprentice training in the late thirties and early forties. This was checked temporarily by the Selective Service Law prior to our entry into World War II. The aggravated trade picture of the war years is well known: training miracles were called for and performed to meet the demands of wartime production and maintenance. The war's aftermath found pent up consumer demands, programs for the rehabilitation of Europe, and growing military needs which maintained war level demands at first, and later increased production demands and with them the need for tradesmen and apprentice training. Likewise, national and state legislation affecting labor and ex-servicemen placed new demands upon the training programs of educational institutions and industries. To meet these demands, Carnegie-Illinois developed a new apprentice program, the purpose of which was to maintain, in the plants of the company, a complement of skilled tradesmen adequate to maintain its facilities and equipment at a high degree of efficiency. To accomplish this purpose the trade education of a young man in apprenticeship is based upon four specific objectives which are:

1. To develop skill in performing the duties of his trade.
2. To advance his technical knowledge of subjects related to the trade.

Figure 1 — Bonded piers are faced on all sides using a line.

Figure 2 — Lesson covers construction of well walls with various wall thicknesses and proper handling of brick hammer.

Figure 3 — Open hearth furnaces — port end.

3. To impart an understanding of the problems of industrial management and the place of industry in the community.
4. To encourage continuing self-education and ambition toward advancement in the organization.

The length of apprenticeship varies with trades from eight periods of 1,040 hours each to four periods of 1,040 hours each. The schedules of the pay rate for each of the periods, with the exception of electrical linemen, are:

1st	period	$1.18½ per hour
2nd	period	1.23 per hour
3rd	period	1.27½ per hour
4th	period	1.32 per hour
5th	period	1.36½ per hour
6th	period	1.41 per hour
7th	period	1.50 per hour
8th	period	1.59 per hour

The rate for the linemen for each period is:

1st	period	$1.18½ per hour
2nd	period	1.23 per hour
3rd	period	1.27½ per hour
4th	period	1.32 per hour
5th	period	1.41 per hour
6th	period	1.54½ per hour

To determine the number of apprentices to be appointed for each of the trades, at each plant a forecast is made periodically which comprehends the normal complement of journeymen in the shop, the anticipated terminations due to age and other reasons, the expansion of curtailment of shop activities, and the number of apprentices presently employed. To illustrate the method let us suppose the normal complement of machinist journeymen in a plant is 85; the anticipated loss due to age, 3; terminations for other reasons 5; expanded operations will demand 4 and the number of presently employed apprentices, 8.

Journeymen	85
Loss — age	3
Loss — other reasons	5
Expansion	4
Total needs	12
Apprentices now employed	8

$85 - 12 + 8 = 81$

Therefore, we should appoint 4 apprentices.

Figure 4 — Constructing front wall as done on furnace rebuild, cutting flare on jambs, constructing arches and leveling over arches using shape brick.

After the number of appointments to apprenticeship has been determined for each trade by plant, candidates are screened from present employees and other applicants.

All candidates for apprenticeship must possess definite qualifications which are: first, the candidate must be an American citizen or have first citizenship papers at the time of acceptance for apprenticeship; second, he must be at least eighteen years of age, but with no maximum age limit, however, in the case of applicants 25 years of age or over, each case is considered by the plant on an individual basis. Third, he must be a high school or vocational school graduate, or the equivalent. Fourth, he must be physically capable of performing the duties of the standard rate classification in the trade of his choice.

Applications for apprenticeship may be filed at any time throughout the year, and if the applicant possesses the required qualifications he is scheduled for the qualifying examinations. If not, this fact is explained to him immediately.

The qualifying examinations for applicants who successfully pass the preliminary interview may be conducted at any time throughout the year. All applicants who do not meet the standards of the qualification examination are so notified by the personnel division. Those who meet these standards are referred to the general supervisor of training, the superintendent of the employing division or department, and shop foreman concerned.

Applicants who are chosen are notified of their appointment to apprenticeship. Those referred for final interviews but not selected for apprenticeships are informed of this fact by the personnel division.

The apprentice immediately goes into training, and in each year of training, receives 1,880 hours of on-the-job training in the shop and 200 hours of related instruction. However, candidates for apprenticeship, who possess previous experience directly related to the trade in which they are enrolled, may be granted credit for this experience. Likewise, apprentices who demonstrate outstanding ability during their training period may also receive a credit award.

The apprentice must meet the required shop and related instruction requirements for the period in which he is enrolled before he can advance to the next higher period of training. To complete the final period of apprenticeship, he must attain the required grades for

Figure 5 — Leveling over arches with cut brick (no shapes).

this period in related instruction subject units for the trade, and the appraisal of "full skill" by shop supervisors in all the basic factors of the journeyman classification record for the trade.

Upon successful completion of the prescribed course of training for the trade or craft, the apprentice receives an engraved and framed certificate of apprenticeship and is assigned the established starting rate of the respective trade or craft. Thereafter, he accedes to the intermediate rate at the end of 1,040 hours of actual work experience with the company in the trade or craft and thereafter, to the standard rate (or top rate) at the end of an additional 1,040 hours of actual work experience in the trade or craft.

The above is a brief summary of how our apprentice program works and what it strives for. However, what are the things that make it work, enable it to achieve its goals, breathe life into it? To show this, it is necessary to backtrack a few years to the planning stage of our new apprentice program. The purpose of the plan is typical, "to maintain in the plants of the company a complement of skilled tradesmen adequate to maintain its facilities and equipment at a high degree of efficiency." Our program varies from the typical in the four objectives that were set down as necessary to accomplish this purpose and in the methods and material selected to reach the objectives.

Let us consider objectives one, to develop skill, and two, to advance his technical knowledge. When the apprenticeship plan was put into effect June 1, 1946, it

Figure 6 — Constructing, cutting and bonding of an octagon corner.

was decided that proper instruction must be insured and provision was made to give the instructors preliminary training. As a first step, a sixteen to twenty-hour teacher-training conference was developed and was given to all new instructors and in some cases to the older instructors. This instruction included preparation of instructional material, preparation of the class to receive instructional material, presentation, types of tests, and adequate discussion after testing. To further minimize the danger of incompetent instruction, related material was prepared for each trade.

This is an important point to us as we have a unique journeyman and apprentice problem as our journeymen are primarily concerned with maintenance work. Therefore, at most of our plants there are no large numbers of apprentices in any one trade. This creates a multitude of training and administration problems.

One ramification is this, because journeymen and

Figure 7 — Constructing one type of open hearth furnace corner.

apprentices are concerned primarily with maintenance work, it is impossible to start apprentices with the most simple jobs of their trade as might be done if they were engaged in production. The jobs must be taken as they come, and this makes coordination of shopwork and classroom work difficult. We handle the problem in this manner. Where adequate material can be secured from regular text books, we have and are developing workbooks. The text book is used as a basic text from which the apprentice can study and the workbook is used as a study guide. Where adequate instruction material cannot be obtained from regular text books, both trade theory manuals and workbooks will be developed. The workbooks and trade theory manuals are developed by representatives from individual plants who were chosen by the maintenance committee.

Figure 8 — Constructing back wall and corners on a rough foundation.

Figure 9 — Using saddle centers to install arch as in hot patching of roof.

Another ramification of primary concern with maintenance rather than production is that in many of the trades, the number of apprentices does not justify having a single teacher, therefore, groups of trades are taught in one class. To accomplish this, mathematics workbooks, blueprint reading workbooks, trade theory workbooks, physics workbooks, etc., are developed. This aid is invaluable where the few numbers of several trades are grouped together and taught in one class by an instructor unfamiliar with some of the trades. In most instances an instructor is hired to teach mathematics and physics, and another instructor is hired to teach blueprint reading. Periodically, a third instructor for each trade is brought in to teach trade theory. In groups where the class is large enough to justify an individual teacher, a tradesman with some college background is appointed to teach all subjects. At one of our larger plants there is an individual teacher for each trade, who gives all the related instruction for that particular trade and acts as a job trainer for job instruction training.

The problem of administration is obvious, and tight control was set up to insure full skill development and complete technical knowledge. For all trades there is a schedule of shop practice which must be adhered to in all plants. In this schedule of shop practice there is a minimum and maximum number of hours that an apprentice must spend at each operation in order to finish his apprenticeship. Records are kept so that the apprentice, supervisor, and training director know at all times how far along each apprentice is in the various trade jobs during his apprenticeship. The apprentice must attain full skill in every item of his training schedule of shop work.

Let us consider objective three, to impart an understanding of the problems of industrial management, and objective four, to encourage continuing self-education. It is recognized by all shop supervision that much of our related instruction material goes beyond the needs of a full-skilled tradesman. This is in keeping with the third and fourth objectives. The additional training is designed to enable the maintenance groups to get adequate supervisory replacement from the ranks. If the apprentices do not receive the instruction prior to entry into journeymanship status, it is doubtful that they will receive it after becoming journeymen.

In fact, it is quite common for graduate apprentices to be chosen as gangleaders, foremen, and to a great extent instructors of future apprentices. It is also quite common for the apprentice instructor to move into foreman or supervisory positions. If we do not train apprentices so that they are able to do more than is required of a journeyman in his everyday work, where will we get our craft supervisors for tomorrow? If we choose one or two individuals and then give them more than you give the entire group, and they should leave, our effort to obtain replacements will have to be duplicated. To further objectives three and four every opportunity and encouragement is given the apprentice to attend night school and college classes.

What specifically do we do about the third objective? In order to give the apprentice a better understanding of the problems of industry, an effort is made to show that the prime reason for operating any industry must be to make a profit. This is done primarily by sound-

Figure 10 — Constructing furnace front wall piers as in doing hot patch work.

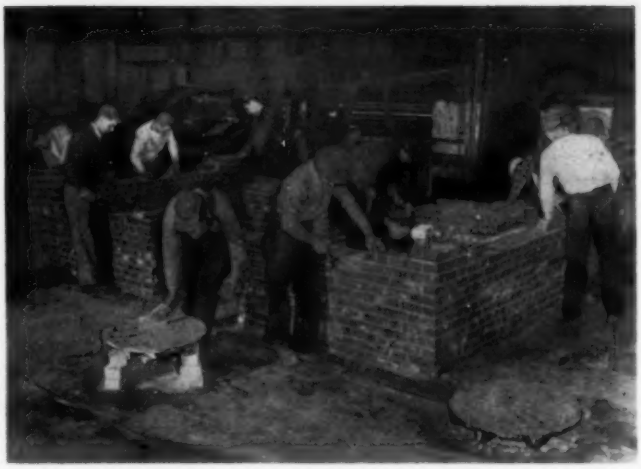


Figure 11 — Constructing common brick wall and practicing handling and use of trowel, plumb and level.

slide films, movies, and a short course in economics. We stress that be it the steel industry, a grocery store, or any other type of business, to make a profit the industry must be able to sell the efforts expended by its workers for an amount which will pay their wages, set aside monies for depreciation of machinery, buildings, etc., and to buy new machinery when old machinery becomes antiquated.

We realize this is not one of the main objectives of our apprentice program, but certainly if this phase of the training is neglected there can be nothing but constant misunderstanding between the apprentice and the supervisor. Every effort is made to get the apprentice to think of a little business endeavor in which he might be interested and then have him apply his conclusion on a large scale to our particular industry.

These few examples have demonstrated the things we believe are the breath of life to the Carnegie-Illinois apprentice training program. Figures 1-11 show how we have developed our training for one or two trades based upon our plan and objectives.

In looking to the future it can be said that the only rigid and inflexible parts of our program are its purpose and objectives. Probably change can come about through three methods, first, training developments and new training methods that demonstrate worth will be reviewed to see if they can be utilized in our trade apprentice program.

Second, as demands for production change and the character of personnel changes, we will adjust our plan and administration to meet these particular needs. For example, if in the future the bulk of those asking to enter apprenticeship were college graduates instead of the now predominating high school level, we would adjust our methods and material and perhaps the length of apprenticeship.

Third, as we anticipate technological developments will place new demands on craftsmen, changes will be made in the training of apprentices to meet these demands. At present, in our electrical trades we are certain that electronic equipment will supersede much of present control systems and we are developing electronic courses plus electronic manuals and workbooks to meet these demands of the future for our "Tradesmen for Tomorrow."

On-the-Job and Related Instruction Training

By THOMAS W. BOULTER

Superintendent, Mechanical and Construction

and Chairman of the Joint Apprenticeship Committee

John A. Roebling's Sons Co.

Trenton, N. J.

ALTHOUGH World War II was the main cause for the shortage of mechanics and skilled workers in general, many companies had set aside their apprenticeship programs before this period, consequently when industry found it necessary to acquire skilled help to make the change from wartime materials to their normal products, machine operators, single purpose or limited skill personnel were fairly plentiful but the skilled craft or tradesmen were lacking.

TO _____ DATE _____

_____ COMPLETED _____ HOURS ON _____

THE WEEK ENDING _____ SECTION 8 OF THE SUPPLEMENT TO THE STANDARDS OF APPRENTICESHIP AUTHORIZES _____

HOURS OF _____.

WOULD YOU PLEASE SEE THAT THE APPRENTICE IS MOVED FROM THIS SCHEDULE ON THE COMPLETION OF THE AUTHORIZED TIME.

_____

PHR:HTW

Figure 1 — Form is used to notify foreman that the apprentice has completed an assignment and assignment should be changed.

Figure 2 — Notification from the training department that the apprentice has met needed qualifications and should be advanced to the next grade of pay.

_____ _____

TO _____ DATE _____

APPRENTICE _____ HAS COMPLETED HIS _____

HOURS ON _____ THIS WILL MAKE HIM ELIGIBLE FOR AN INCREASE IN PAY FROM $ _____ PER HOUR TO $ _____ PER HOUR, EFFECTIVE BEGINNING _____.

I SHALL GREATLY APPRECIATE IT IF YOU WILL ATTEND TO THIS MATTER

_____

PHR:HTW

_____

This inability to obtain the needed craftsmen made it essential to start a very strenuous apprentice program in our company. By joint agreement between the company and the union, it was decided that the apprentices should start at the prevailing base labor rate in the plants and the ratio of apprentices to journeymen agreed upon was one in seven, or part thereof, for each craft. Especial care was taken in the selection of apprentices with first preference given to any of our employees who could meet the requirements as established in our standards of apprenticeship.

There are thirty-eight apprentices in the employ of the John A. Roebling's Sons Co.; these are distributed throughout ten crafts or trades in the following order:

9 Machinist apprentices
6 Electrician apprentices
4 Pipefitter apprentices
3 Tinsmith apprentices
6 Carpenter rigger apprentices
6 Bricklayer apprentices
1 Welder apprentice
1 Patternmaker apprentice
1 Heat treater apprentice
1 Blacksmith apprentice.

All are veterans; the average age is twenty-six years. All are high school graduates or equivalent, and were chosen from a large number of applicants.

The following tests were used to determine qualifications:

1. Otis Gamma—Intelligence or mental ability test.
2. Mechanical comprehension.
3. Personal inventory.

A joint apprenticeship committee composed of two union and two company representatives selected the above applicants, with both the company and the union having interested parties at the time of selection. All were chosen on the basis of personal qualifications and standings in the above tests.

The apprentice training program is fully accredited and registered with the United States Department of Labor, Federal Committee on Apprentices. International Correspondence School text books and courses are used for the related instruction part of the training. This is supplemented by four hours per week of classroom study, for which time the apprentice is paid by

Figure 3 — Front of apprentice shop record.

Apprentice SHOP Record

Name_____ Address_____ Phone_____ Clock No._____

Age last birthday_____ Date of birth_____ 19____ Previous Schooling_____

Name of Parent or Guardian_____ Address_____ Nationality_____

WAGE RATE	Date	Rate	WAGE RATE	Date	Rate
Employed			5th. Change		
1st. Change			6th. "		
2nd. "			7th. "		
3rd. "			8th. "		
4th. "			9th. "		

Reports to Parents Check when each Report is sent	First Year				2nd		3rd		4th	
	1	2	3	4	5	6	7	8	9	10

Remarks:

Date	TYPE OF WORK OR MACHINE	Progress by Weeks in Shop																									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

PERSONALITY RATING SCALE: I. By Foreman II. By Apprentice Supervisor

	1="Good" or "Yes". 2="Fair" or "Medium". 3="Poor" or "No".	1st Year				2nd		3rd		4th		Total	1st Year				2nd		3rd		4th		Total	Grand Total
		3 Mo.	3 Mo.	3 Mo.	3 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.		3 Mo.	3 Mo.	3 Mo.	3 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.	6 Mo.		
A	Is he industrious?																							
B	What is the quality of his work?																							
C	Is he a rapid worker?																							
D	Does he follow instructions?																							
E	Has he initiative?																							
F	What is his Deportment?																							
G	Is he liked by his fellow workers?																							
H	Does he possess leadership ability?																							

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the company at his regular rate of pay. This period is supervised by one of three staff engineers who are graduates of either Rutgers or Alabama Universities.

The joint apprenticeship committee, besides selecting the apprentices, meets once a month to discuss problems which arise pertaining to the administration of the program. A normal monthly meeting will cover such items as the transferring of apprentices from one assignment to another, job training processes, settlement of apprentice complaints, and a review of the apprentices' progress records, both on-the-job and related instruction.

This committee serves for one year but may be reelected; union representatives must be bona-fide craftsmen, and interested third parties are always welcome at these meetings. Always in attendance is a member of the company's training department, under whose supervision the records are kept up to date and contacts with the Veterans' Service Bureau are made.

The first six months or 1000 hours are a probationary period for new apprentices. After successful completion of this period, the apprentice's hourly rate is increased, and every six months or one thousand hours thereafter, in accordance with the "Standards of Apprenticeship" signed and agreed to by both the company and the union.

A general outline of the related instruction given to the apprentices is as follows:

Mathematics — Section 1. Industrial Economics, Elements of Arithmetic, Fractions, Decimals, Weights and Measures, Ratio and Proportion, Powers and Roots, and Mensuration.

Section 2. Industrial Economics, Arithmetic Examination, Elements of Algebra, Logarithms, The Slide Rule (optional), Geometry and Trigonometry.

Drawing — Section 3. Geometrical Drawing, Elements of Projection Drawing, Practical Projection and Development of Surfaces including Sheet Metal and Molding Development.

Machinist Apprentice—Trade Subjects—Elements of Mechanics, Part 1 and 2; Elements of Fluid Mechanics; the Slide Rule; Measuring Instruments; Precision Measuring Instruments; Drilling Machines; Drilling Practice; Lathes; Lathe Tools, Lathe Practice, Part 1 and 2; Lathe Thread Cutting; Turret Lathes; Turret Lathe Practice; Automatic Lathes; Planers; Planer Practice; Shaper and Slotter Work; Boring Mills; Milling Machines; Milling Machine Equipment;

Figure 4 — Back of apprentice shop record.

Apprentice RELATED INSTRUCTION Record

Course _____ I.C.S. Class Letter & Number _____ Date Enrolled _____ Paid in Full _____ Date Completed _____

I.C.S. Lesson Serial No.	Subject	Date ASSIGNED	COMPLETED and Mailed	Date RETURNED	Grade

Milling Machine Practice; Milling Machine Indexing and Spiral Work; Gear Calculations; Gear Making, Part 1 and 2; Grinding Equipment; Tool Dressing; Bench Work, Part 1 and 2; General Applications and Processes; Hardening and Tempering.

Electrician Apprentice—Trade Subjects—The Slide Rule; Elements of Mechanics, Part 1 and 2; Elementary Electrical Principles; Electrostatics and Magnetism; Direct-Current Generators and Motors; Alternating-Current Generators, Transformers and Rectifiers; Alternating-Current Motors and Control; Electrical Measuring Devices; Practical Electrical Measurements; Industrial Motor Applications; Direct-Current Armature Repair; Field Coil and Brush Maintenance; Care and Repair of Fractional-Horsepower Motors, Part 1 and 2; Rewinding and Reconnecting Fractional-Horsepower Motors; Alternating-Current Motor Repair, Part 1 and 2; Rewinding and Reconnecting Induction Motors; Electric Illuminants, Part 1 and 2; Illumination Principles; Electric Heating, Part 1; Practical Electrical Wiring, Part 1; Electric Heating, Part 2; Practical Electrical Wiring, Part 2; Practical Electrical Wiring, Part 3; Local Distribution of Electrical Energy; Switchgear, Part 1 and 2.

Pipefitter Apprentice—Trade Subjects—The Slide Rule; Elements of Mechanics, Part 1 and 2; Elements of Fluid Mechanics; Strength of Materials; Plumbing Tools and Materials, Part 1 and 2; Soldering, Brazing and Wiping; Pipework; Pipes and Fittings; Steam-Fitting Auxiliaries; Principles of Heating; Radiators and Convectors; Heating Boilers; Heating Boiler Accessories; Pipe-Fitting Tools; Pipe-Fitting Practice, Part 1 and 2; Steam Heating Systems, Part 1 and 2; High Pressure Pipe Fitting; Heating Specifications Part 1 and 2.

Carpenter Apprentice—Trade Subjects—The Slide Rule; Carpentry, Part 1, 2, 3, 4, 5, and 6; Millwork, Part 1, 2, and 3; The Steel Square, Part 1 and 2; Stair Building; Roofing, Part 1 and 2; Forms and Centering, Part 1 and 2; Builders' Hardware; Specification Writing, Part 1 and 2; Specification-Writing Memoranda.

All of the above are International Correspondence School approved subjects, and are forwarded to their Scranton office for grading and corrections. These are returned to the training department for record purposes, and then to the study period staff engineer for discussion with the apprentice.

Also included as part of the study period are lectures given by representatives of the different companies on such items as correct selection and uses of files, a lecture supplemented by a number of pamphlets and textbooks on correct selection of taps, their care, lubrication, etc., as well as plant safety lectures.

In setting up the "Standards of Apprenticeship" a regular schedule of hours was set up for the apprentices' supervisor to follow. A daily report to the training department, of the apprentices' assignments for the previous day, assures an accurate running record of the hours worked, and consequently a minimum overrun of hours as outlined results.

The following schedules of hours and work assignments are all as agreed to and, in most cases, do not vary over or under by 5 per cent, the allotted hours. All trades were set up for a 4-year or 8000-hour training period.

MACHINIST APPRENTICE

A machinist apprentice will receive 200 hours of time in the tool crib. This is to familiarize him with the men with whom he will work, and will also make him realize how important it is to report damage to tools and to return them to the tool crib when not being used. During this time he also learns to grind drills and keep an inventory of tools so that replacements are made continually.

He may next be assigned to the drill presses where he will, before he has completed his apprenticeship, receive some 350 hours of practical instruction. This work includes sensitive as well as large radial work. It will include machine tapping, reaming, and boring, or any and all types of work normally performed by a drill press operator.

The shaper assignment is for a period of 600 hours. Usually this is broken up into three periods of approximately 200 hours each, during which times the type and quality of the work improves as the apprentice progresses and acquires experience.

Five hundred hours have been allotted to planer work of all types. Lathe work is allotted some 1250 hours, during which time the apprentice will operate small bench lathes and work on up to the larger machines. This period is broken up into four sections as much as possible, and every effort is made to see that he is given practical experience in every phase of lathe work. This includes straight turning, boring, and multiple thread cutting. A portion of this time is also taken up on repair work requiring running, press, and very close tolerance fits.

Work on the milling machines requires an allotment of 700 hours, during which time the apprentice will learn indexing for gears, vertical milling, slotting with a miller slotting attachment, and a complete knowledge of all phases of milling machine work.

Vertical and horizontal boring mill work is scheduled for another 700 hours, this to be as evenly divided as possible.

Gear hobbers and shapers have been given 300 hours of training and although these machines are normally production machines, it was felt that a general working knowledge would do no harm inasmuch as it would tend to impress upon the apprentice the accuracy required when machining gear blanks, etc.

All machinist apprentices are given some 800 hours in the tool room, during which time they are given training on surface, tool and cutter, and universal grinders. Special care is taken to instruct them in tool and cutter grinding, both on carbide tools of all descriptions, as well as milling cutters, plain and helical, gear hobs, reamers, and all general tools in use throughout the shops.

Heat-treating, layout and bench work have been set up for some 1500 hours. During this time the apprentice will assist in structural and machine part weldments set-up, assembly of special machines designed and built by our company, and then given a working knowledge of heat-treatment in the heat-treating department.

At various times throughout the four-year period, the apprentices will be assigned to assist a machinist in

the installation and repair of mill equipment. This is intended to give the young mechanic a general picture of the machines in production throughout the different divisions of the company. This time, coupled with approximately 600 hours of related instruction, brings the total hours to 8000, which under normal operating conditions is equal to four years.

ELECTRICIAN APPRENTICE

The apprenticeship program in the electrical departments is broken down in the following manner.

An apprentice will receive approximately 500 hours of time in the stockroom, during which time he will learn stock handling methods and types of stock usually carried.

About 500 hours time will be devoted to the lighting systems, miscellaneous service, and repairs. During this time the apprentice will get acquainted with plant and location of buildings while making small repairs, replacing lamps, etc.

The apprentice will spend approximately 1900 hours of time learning methods of installing wiring, circuits, motor and transformer connections, etc.

About 250 hours of the apprentice's time are allotted to overhead lines, construction, and repair. This covers learning to climb and principles of line construction.

Approximately 2000 hours are allotted to motors and controls, which includes service and repair, learning fundamentals of various type motors and controls—both a-c and d-c. Some of this allotted time is also given to crane and hoist repairs.

Some 750 hours are spent learning to repair commutators and to acquire a general knowledge of armature winding, both a-c and d-c.

The apprentice will spend approximately 250 hours of time working with batteries and associated equipment. This phase of the program will cover battery charging, tractor service and repair, control battery installations, fire alarm, clocks, etc.

The apprentice will spend about 250 hours in mill maintenance, working along with mill maintenance men, learning methods employed in the various mills, and getting acquainted with special equipment in the mills.

During this program, the apprentice will be assigned for approximately 750 hours to some instrument and control group to become acquainted with various types of instruments and controls in use throughout the plant.

Some 250 hours are allotted to electrical meters. Included in this phase of work is the use and repair of electrical ammeters, voltmeters, wattmeters, watthour meters, etc.

About 600 hours of the apprentice's time are to be spent in organized class study, which together with the aforementioned phases of electrical work, brings the total up to 8000 hours.

PIPEFITTER APPRENTICE

This training period is broken down into the following:

About 1000 hours are spent in the shop. During this time the apprentice will learn the types, uses and care of hand tools. He will work with a tradesman on different types of pipes and fittings and learn to recognize them and their measurements. He will repair all types of valves, thus becoming familiar with their construction, and will receive practical experience on the shop equipment by daily use under supervision.

Some 2500 hours of training time have been allocated to general maintenance and repairs. During this period of time, the apprentice will assist a pipefitter in making repairs to piping and equipment throughout the plants. This consists of repairs to steam, gas, air, acid, and oil lines, etc., repairs to fire protection equipment, and assisting in the repairs of boiler house equipment.

For the repair and maintenance of sanitary lines and equipment, 600 hours have been allotted.

About 1500 hours are devoted to new construction, consisting of installing new overhead, surface, concealed, and underground lines, and the proper support of the same. This will permit the apprentice to learn to cut and make joints in cast iron pipes, and install necessary piping for meters and control equipment.

Repairs to flow, control, and measuring equipment, such as gages, meters, regulators, and safety valves will require 600 hours.

About 1200 hours of time have been allocated to heating system experience. During this time the apprentice will learn to install systems, the correct placing of traps, valves, return lines, etc. This phase of training also includes installing furnace piping, burners, and heating regulators.

At about the middle of the apprentice's third year of related instruction, he will be receiving as part of the I.C.S. course, a series of lessons and examinations in hydraulics, or the application of the mechanics of fluids and elements of heat.

TINSMITH APPRENTICE

About 1250 hours of the apprentice's time will be spent in the shop, learning the use and care of hand tools, kinds of material and use, location of supplies, learning to solder and rivet, and as a general helper to the mechanics.

Some 1250 hours will be devoted to building repairs. This includes repairing, roofing, spouting, gutters, heaters, and smoke pipe.

As part of this training, 1250 hours will be given to learning to erect sheet metal guards, hoods, ducts, etc.

Construction work will require 1250 hours of apprenticeship training time. During this time the apprentice will learn to lay corrugated iron, slate, built-up composition, and tin roofing. He will also learn to hang sheets on partitions and sidings, and learn to properly install flashings and gutters.

Some 2400 hours of the apprentice's training time will be spent in shop work. This will include sheet metal layout, fabrication, and installation; learning to make and use various types of joints, soldered, locking seam, and riveted. Also included in the shop work is the making of guards, special shapes, constructing and installing duct work, and learning the use of shop tools.

CARPENTER APPRENTICE

About 1250 hours of training are devoted to shop work, during which time the apprentice learns the use and care of hand tools, types of material, and location of supplies.

Some 1250 hours are given to miscellaneous building repairs, such as repairing doors, windows, and floors.

Concrete form work is allotted 750 hours of time and includes layout of foundations, building and stripping different types of forms.

Building construction is allotted 1800 hours of training time. During this time the apprentice learns framing, joists, studs, rafters, etc. Also included are kinds and uses of sheathing and flooring. The apprentice also learns to hang doors and windows, build stairs, and install trim.

This phase of training includes 1250 hours of work with rigger to learn material handling, scaffolding, machinery locating and setting, use of ropes, slings, hoists, rollers, etc.

About 1100 hours of time are spent in the shop learning use of woodworking machinery, saws, lathes, planes, jointer, mortising machine, shaper, etc.

BRICKLAYER APPRENTICE

About 500 hours of time are spent assisting a brick-

Figure 5 — Apprentices are rated on a personality rating scale.

PERSONALITY RATING SCALE

APPRENTICE _____

CLOCK NO. _____ DEPARTMENT _____

TRADE _____ DATE _____

I.C.S. CLASS LETTERS AND NUMBER _____

1 = "GOOD" OR "YES" 2 = "FAIR" OR "MEDIUM" 3 = "POOR" OR "NO"

KEY	PERSONAL TRAIT	RATING
A	IS HE INDUSTRIOUS?	
B	WHAT IS THE QUALITY OF HIS WORK?	
C	IS HE A RAPID WORKER?	
D	DOES HE FOLLOW INSTRUCTIONS?	
E	HAS HE INITIATIVE?	
F	WHAT IS HIS DEPORTMENT?	
G	IS HE LIKED BY HIS FELLOW WORKERS?	
H	DOES HE POSSESS LEADERSHIP ABILITY?	

REMARKS

1. SINCE YOUR LAST REPORT, WHAT HAS THE ABOVE APPRENTICE DONE THAT HE WAS NOT ASKED TO DO, THAT REVEALED HIS INTEREST IN HIS TRADE, HIS FELLOW-WORKERS, OR HIS COMPANY?

2. WHAT MORE CAN BE DONE TO ENCOURAGE AND HELP THIS YOUNG MAN IN ANY WAY?

SIGNED _____

OVER: FOREMAN OR APPRENTICE SUPERVISOR

Figure 6 — Back side of personality rating scale.

SUGGESTIONS TO SUPERVISORS

AN APPRENTICESHIP IS A PROGRAM OF GROWTH.

INCREASINGLY, OVER A FOUR-YEAR PERIOD, EACH APPRENTICE SHOULD BETTER HIS SKILL, HIS TECHNICAL KNOWLEDGE AND HIS ABILITY TO GET ALONG WITH OTHERS. HIS INTEREST IN HIS TRADE ALSO SHOULD INCREASE.

HIS PROGRESS THROUGH THE WORK-SCHEDULE FOR HIS TRADE, HIS INCREASING SKILL AND PRODUCTION ARE ALL INDICATED IN A PERMANENT SHOP RECORD.

THE PERSONALITY RATING SCALE ENABLES THE APPRENTICE SUPERVISOR, AND THE FOREMEN UNDER WHOM EACH APPRENTICE GETS HIS TRAINING, TO NOTE THE GRADUAL IMPROVEMENT IN HIS PERSONAL TRAITS.

WHEN SCORING, TAKE INTO CONSIDERATION THE LENGTH OF TIME THAT THE APPRENTICE HAS BEEN IN TRAINING.

INCIDENTS OUT OF THE DAY'S WORK OFTEN ARE IMPORTANT STRAWS SHOWING THE DIRECTION IN WHICH THE APPRENTICE IS MOVING. REPORTED UNDER REMARKS, THEY PROVIDE A RUNNING RECORD, OVER A FOUR-YEAR PERIOD, THAT SHOWS HIS IMPROVEMENT AND GROWTH, BOTH IN THINKING AND DOING.

THE PERSONALITY RATING SCALE ALSO ENABLES THE FOREMEN AND THE APPRENTICE SUPERVISOR TO WORK TOGETHER IN SOLVING VARIOUS PROBLEMS WHICH ARISE AND IN PERSUADING YOUNG MEN TO COMPLETE THEIR APPRENTICESHIP.

EVERY REPORT IS STRICTLY CONFIDENTIAL.

layer with small jobs, learning plant location, types and names of materials, sources of supply, and stock items.

Some 500 hours of time are devoted to concrete work of all types. This includes learning how to mix, pour, and finish.

About 500 hours of time are devoted to plastering, mixes of brown coat and white coat, and correct application.

General brickwork, consisting of wall and building construction, repair, and general construction using brick, mortar, and other mason materials, is given 1000 hours.

Furnace and boiler repairs, including open hearth furnace construction and repair, is given 4300 hours of apprenticeship training time.

Some 624 hours of time are devoted to work with acid tank and open hearth ladle linings.

Related instruction is also included under this program to the extent of 576 hours.

WELDER APPRENTICE

The welder apprentice spends 550 hours of his training time assisting welders in all phases of their work, learning materials and types and grades of rod, both electric and gas.

About 1350 hours of time are spent learning to select stock, layout from blue prints, and burning to required shape by hand or machine torch.

Some 600 hours of time are devoted to erecting, clamping, and tack welding.

Approximately 2100 hours of time are devoted to all positions and types of electric welding.

Some 1924 hours of training time are given to all positions and types of gas welding.

About 900 hours of training time are given to all positions and types of brazing welding.

About 576 hours of related instruction are given in connection with this apprenticeship program.

PATTERNMAKER-WOOD APPRENTICE

Some 400 hours are devoted to assisting patternmaker as general helper, learning to select correct materials, care and use of tools, etc.

About 600 hours of time are given to assisting patternmakers in finishing patterns by setting in fillets, sanding, shellacing, and painting same.

Approximately 400 hours of the apprentice's time are spent in plain shop work.

About 500 hours of time are spent in wood turning of all types.

Some 1200 hours of the apprentice's time are given to assisting patternmaker on large patterns and core boxes.

Making layouts from prints for sample patterns is given 400 hours of training time.

The apprentice spends 1914 hours making small patterns and core boxes.

About 1100 hours have been allotted to making large patterns, core boxes, etc.

Practical experience in all-round general pattern and core box making takes up 900 hours of apprenticeship time.

Since this is normally a five-year apprenticeship, the last year the apprentice will be paid the same rate as a third class journeyman, but will be under the direct supervision of the foreman at all times on work assignments.

BLACKSMITH APPRENTICE

About 500 hours of the apprentice's training time will be spent as a general helper in the shop, learning stock, types of material, tools, and equipment.

Some 1200 hours will be spent making small forgings using hand tools.

The apprentice spends 1300 hours of time to forging larger forgings using nazel and similar type of hammer.

Approximately 1250 hours of training will consist of use and operation of steam and air hammers for heavy forgings.

During 3174 hours of training time, the apprentice will do general blacksmith work, form structural shapes, general maintenance, forge tools, star drill bull points, and temper same, operate upsetting machine and make intricate forgings.

About 576 hours are devoted to related instruction.

DISCUSSION

PRESENTED BY

E. C. PETERSON, Engineer, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

L. F. COFFIN, Superintendent, Mechanical Department, Bethlehem Steel Co., Sparrows Point, Md.

H. S. HUNT, Assistant Chief Plant Engineer, John A. Roebling's Sons Co., Trenton, N. J.

W. E. BOUDMAN, Assistant to Management's Representative, Bethlehem Steel Co., Steelton, Pa.

A. J. FISHER, Assistant Chief Engineer, Bethlehem Steel Co., Bethlehem, Pa.

KARL R. FRIEDMANN, Girard College, Philadelphia, Pa.

L. V. BLACK, Superintendent, Electrical Department, Bethlehem Steel Co., Bethlehem, Pa.

M. B. ANTRIM, Superintendent, Electrical Maintenance, Lukens Steel Co., Coatesville, Pa.

NORMAN C. BYE, Director of Engineering, Henry Disston and Sons, Inc., Philadelphia, Pa.

GEORGE M. KENNEDY, Assistant to Director, Education and Training, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

T. W. BOULTER, Superintendent, Mechanical and Construction, John A. Roebling's Sons Co., Trenton, N. J.

E. C. Peterson: I would like to ask both of these gentlemen what they have done in the field of training draftsmen?

L. F. Coffin: Apprenticeship training started at Spar-

rows Point in the 1890's. As a matter of fact, our machine shop, pattern shop and foundry and to some extent our brick department, has been largely self-sustaining by means of apprentices for all those years. The machinist apprentice is one of the finest sources of supply for future leadership in mill repair work.

Your system of rotating apprentices throughout the various phases of the work is excellent. We follow the same scheme, and your suggestion of having the apprentices' report is a good check up on their actual rotating experience.

H. S. Hunt: I was very much interested in Mr. Kennedy's statement that they have a different number of years for apprenticeship training for the various trades, ranging from two to four years. Our apprenticeship training period is four years for all trades. We do not have apprentices in the painters' trade, but the others as listed in Mr. Boulter's paper are all for four years. When we took this up originally with the Federal Committee on Apprenticeship, U. S. Department of Labor, they preferred the four-year period. We decided to conform to their recommendations and stuck to four years for all trades, giving apprentices' certificates on that basis.

Another apparent difference in our experience compared with those of the U. S. Steel Corp. has to do with relations with the union. I take it from what Mr. Kennedy says that the Carnegie-Illinois apprenticeship program is not particularly tied up with the union. We have had no difficulty with the C.I.O. union in this respect. They were 100 per cent cooperative and just as much in favor of our starting this apprentice training program as we were. As a matter of fact we have complimented them many times for their wholehearted interest and hard work in getting this apprenticeship program under way. I would also like to mention that we have had no trouble in the selection of apprentices. While the apprenticeship agreement does not state that the union has a voice in the selection of apprentices, still the national representative and the joint apprenticeship committee composed of union and company members get together to discuss the selection of apprentices. The selectees are sent to the superintendent and foreman of the department in which they are to work. If the superintendent or foreman has any reasonable objection to the selection of the apprentice, the objection can be sustained.

W. E. Boudman: I would say the training programs of all these companies are so much alike that we must have worked them out together ahead of time, as there are a lot of cases where they seem to dovetail.

We lean to I.C.S.'s technical books, although we have had some trouble in getting them, particularly since the war, but we started with them and have continued. While Steelton, particularly, has not gone back as far in apprenticeship as our Sparrows Point plant, we go back to the early 1900's. Training was not too far advanced in those days, and the courses of training was not detailed at that time. Often a fellow was started on the lathe, and if he was pretty good he served most of his apprenticeship on the lathe, but he was then called a machinist. Of course, that practice was discontinued quite some years ago.

There is a lot of food for thought in the two papers, and a comparison of the hours spent on the different machines in the machinist trade and also the breakdown in the other trades among the different companies might be of mutual benefit.

A. J. Fisher: During the war I was amazed, as was most every one of us, at the speed in which a great number of men were trained to do specific jobs, and this vestibule training of bricklayers that was illustrated by Mr. Kennedy interested me very much. That takes us back to the point that in our training of men we have a time limit. I would like to have Mr. Kennedy discuss training to meet a specific time.

Karl R. Friedmann: My department is academic, but, knowing the history of our own boys, all of whom get both an academic and a vocational training (they get about 15 hours a week over two years in vocational work) I am concerned that in many industries they get very little if any credit for the preparation they have had with us, and I would like also, to hear Mr. Kennedy and Mr. Boulter speak somewhat to that point.

L. V. Black: Bethlehem has had apprenticeship courses for a number of years. Applicants for these courses must have the education of a trade school graduate, or better. Apprentice training has been very successful and satisfactory in all branches.

In the past, Bethlehem operated apprentice training courses for maintenance men; however, as with other companies, circumstances prevented the continuation of such training.

It is the belief of many that there is a definite need for some type of training course for maintenance men. I would like to know if either Mr. Kenendy or Mr. Boulter has given any thought to the establishment of maintenance training courses.

M. B. Antrim: I should like to ask Mr. Kennedy, in particular, two questions, one of which is going to be practically the same as Mr. Black's, in regard to some of the problems we have run into after establishing a training course for apprentices.

One of these problems deals with the fact that in our organization a large part of the present incumbents are advanced in years of service with the company, and we find that upon advancing apprentices whom we pay to go to school, pay to work, and pay for their books, there is some resentment. Most of this resentment comes from those in a starting or intermediate position in the various crafts. This results in a certain section of our supervision leaning over backwards in an effort to protect, or, shall we say, appease, this group of men.

In this connection one of the points that has come up is the subject of apprentices working overtime. There are various schools of thought on that subject. I realize that in some cases it is necessary to work apprentices overtime. However, this is one way in which they can be held down, appeasing the older element of the trades.

The other question that I had in mind was that due to our organization and the rate structure thereof, the trades naturally offer a greater chance for advancement for any apprentice. Therefore, upon their graduation from the apprenticeship courses they tend to become wiremen, linemen, machinists, and so forth, and our repairmen, are, of course, not receiving any benefit from the apprentice courses.

We have various up-grading courses for repairmen operating under the same act that you mention in respect to state aids. However, we find that due to the fact some of these repairmen have only graduated from the fourth grade in grammar school, while some have not only graduated from high school but have had at least the equivalent of first year college with the armed forces, not to mention that their ages range from 18 to 57, it is pretty difficult to bring them all along at a reasonable rate. I am wondering what solution your company may have found for these two matters?

Norman C. Bye: I was very much impressed with the thought that has gone into the training programs which have been described to us.

In our plant for a number of years we have had operations which have been considered crafts but which are not strictly machinists, electricians, plumbers, etc. They are really highly specialized production operations requiring two or more years of training, and while we have classed them as apprenticeship courses, it is now necessary to determine whether they are true apprenticeships or on-the-job training according to the federal ruling. In many cases it is difficult to determine whether it is an apprentice or a simple job training program.

I would like to ask Mr. Kennedy if he has any definition which would distinguish between an apprentice program and a job training type of program.

Mr. Boulter spoke about the union taking part in the selection of apprentice applicants. I would like to know if the union also takes part in the grading of the progress reports of the apprentices during the program to determine whether the apprentice is satisfactory or not, and if they have as much a voice at that point as they do during the time of his initial selection?

G. M. Kennedy: In order to determine whether a job may be classified as a trade or not, the job requirements and proposed training program may be sent to William Patterson, Federal Apprentice Training Service, Washington, D. C., for review. They will measure the proposed program against certain standards such as the following:

1. Must be two years or more in length.
2. Must require related instruction.
3. Must provide pay progression.

Concerning the vestibule school for bricklayers, this program serves the purpose of teaching beginners certain fundamentals such as how to make joints, lay corners, and arches. This instruction in fundamentals consumes three weeks which minimizes the individual on-the-job instruction needed during the first months of training, although careful supervision is needed in order to consolidate the gains made during the vestibule period.

A question was asked relative to credit given for graduation from a vocational school. Under the Carnegie-Illinois plan no special credit is given to such apprentices although it is possible for an apprentice to receive up to 25 per cent credit for outstanding work during his training.

A question was raised concerning the withholding of promotion. We do this where warranted, assuming, of course, there has been adequate appraisal of the individual's work and discussion of the problem with the apprentice beforehand and that he has had sufficient opportunity to bring his work up to standard.

Overtime was also brought up. We find that it interferes with the related instruction program although it is allowed because apprentices must fit into the production situation as it exists.

Another point which may be of interest is our plan for completing the year's related instruction schedule within nine months which frees the apprentice for full time in the shop during the vacation period, eliminates the instructor problem during vacations, and eliminates classroom work during hot weather.

There was a question about draftsmen. That is not a trade in our corporation, and right now we are in the process of developing an up-grading program for draftsmen. In fact, there is an area in all industries that is really a sort of "no-man's land." A fellow progresses, he takes one step, another step, and another step, and then is stymied. His educational facilities will not take him beyond the barrier. Many draftsmen used to be college graduates. It is difficult to get college graduates on the board now, and if you did have them on the board, you would have to pay them too much, and soon they become dissatisfied and quit unless they are paid an out-of-line rate, so it does not pay. Out in one of our plants we are going to take our tracers and give them mathematics, drawing, physics and mechanics. We even plan on their taking a little strength of materials and design.

T. W. Boulter: One of the questions asked was about overtime. In our standards of apprenticeship, we specifically state that apprentices shall work the same hours and be subject to the same conditions regarding overtime as the skilled workers in the trade employed by the company.

Another question asked, I believe, was about apprenticing repair men. We used to up-grade helpers to journeymen but one week after the signing of our standards of apprenticeship that was discontinued. In order to give an "out" for the progression of helpers, we do give the mill maintenance people, that is the millwrights or repairmen helpers in the field, the chance to be up-graded through the different classifications to millwrights. This is not an apprenticeable trade, but has been jointly agreed to by both the company and the union.

There is one other question about apprentices not meeting the requirements, and did the union members on the joint apprenticeship committee have as much to say as the company members?

Under the terms of our agreement, they do. However, it is set up in such a way that if the joint committee is unable to adjust a matter to the satisfaction of either party, either party may ask the Federal Committee on Apprenticeship to consider the case and make its recommendations thereon. If a satisfactory solution can not then be reached, then a grievance may be filed by the apprentice in accordance with the agreement then in effect between the company and the locals of the United Steel Workers of America.

We have found that we have had very close cooperation with the union, and where any boy has been backward at all, we have called the boy in and discussed his problem and have gone over with the foreman or the study engineer as to where he has been lacking. We then bring the boy before the joint apprenticeship committee, have him give his side of the story, give him a talking to if needed, place him on probation until the condition has been ironed out.

CONTINUOUS CAPACITY OF COPPER WIRE

for Tie Lines

By S. EIN
Electrical Engineer
Armco International Corp.
Chicago, Ill.

. . . . as a result of the study reported, a decision was reached not to build the power line which had appeared to be originally necessary . . . .

▲ THE design of high voltage alternating current lines serving public utilities is usually based on various factors of which the continuous current carrying capacity is a minor one. Contrariwise, in steel mills with large blocks of power to be transmitted over comparatively short distances, the thermal ability of the wire to carry the required current can be of prime importance. Such a case occurred recently and will be described.

The bases for determining thermal ability as used here can be employed in the design of lines of any size and voltage to give current values which are higher than those sometimes assumed as being the true ones. When due respect has been paid to possible higher ambient temperature and solar radiation, the procedure outlined can be used in any area. For all items of the study, references to authoritative sources on record will be quoted as proof.

GENESIS OF PROBLEM

The situation which called for higher current capacity arose because the lines under discussion were installed originally in 1937 to transmit a fairly large amount of 25-cycle power but are now needed to carry a larger block of 60-cycle power, in both cases between two steel mills as shown in Figure 1. The two mills and the lines are located on the southern shore of Lake Michigan.

The interconnection consists of two parallel 4/0, 69-kv circuits on a steel tower line of which a typical support is shown in Figure 2. The continuous rating of each circuit was estimated at the time of installation as 20,000 kw and, therefore, a 20,000-kva, 25-cycle transformer bank was installed at each end of each circuit to interconnect the 22-kv distribution systems of the two plants.

Recently the decision was made to discontinue future expansion at 25-cycles in order to secure the benefits of 60-cycle equipment. As a step in this direction, a 60-cycle preferred standard, 60,000-kw generator was planned for installation at steel mill L, as shown in Figure 1. This location was chosen because, while steel mill L does not as yet have 60-cycle load which can be fed by the new generator, it does have available an adequate supply of blast furnace gas as fuel which is lacking at steel mill R. When the installation of the generator is completed, its output will be transmitted to steel mill R where a growing 60-cycle load is overtaking generating sources of insufficient capacity.

With the above determined, there then arose the problem of the best method for transmitting the power from steel mill L to steel mill R. A new exclusively 60-cycle transmission line could not be installed due to prohibitive cost and difficulties in securing the right-of-way. If both 25-cycle lines were taken from their present use and the ends reconnected for 60-cycle service, the output of the new generator could be easily transmitted on basis of the lines' rating as estimated

at the time of their installation. However, it would be very desirable to retain the 25-cycle tie over at least one line in order to have the flexibility and economy of the interconnection. This could be done if one 25-cycle line was used as interconnection at this frequency, and the other 25-cycle line converted to use as a 60-cycle connection. Dependable operation with one line at either frequency can be secured because experience since installation has shown that the design of the lines for practically lightning-proof operation has been realized.

Since the foregoing reasoning allowed only one line for use as interconnection between the 60-cycle systems of the two steel mills, numerous detailed studies were made on the a-c network calculator with the single 60-cycle interconnection. The studies solved the problem of voltage regulation by specifying a high power factor as being required at the loads of the right steel mill, and the question of stability was taken care of by resorting to the use of circuit breakers with selective pole reclosing [1]*. This left the question of the thermal capacity of the 4/0 copper in the line to be answered.

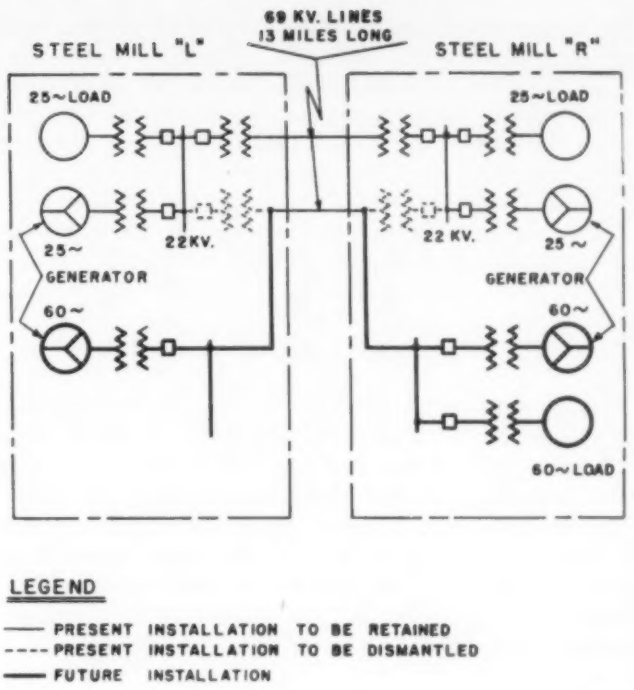

Figure 1 — Schematic diagram showing purpose served by the tie lines.

OTHER ALTERNATIVES

As already stated, one line was insufficient to handle the output of the 60,000-kw generator. An increase in copper size to secure increased capacity was not practicable because this action would require a large expenditure for replacement of the towers. Substitution of A.C.S.R. wire for the copper wire to secure greater capacity was abandoned because when such substitution was used previously on a part of the interconnection which was converted to other use, severe galloping of the conductors caused outages because, it was believed but could not be fully proved, the increase in cable diameter enabled the wind to develop enough force to make the wires gallop, where before with 4/0 copper only slight movement occurred. Possibilities that injurious galloping would be imposed on the interconnection could not be considered.

An increase in line voltage over 69-kv for the interconnection would give increased capacity and the towers would be suitable because the required clearances could be secured; but such increase in voltage would cause great expense for either one of the two consequent results. If the higher voltage of the interconnection was used as the plants' transmission voltage, more expensive towers would be required in the future inside of each works. On the other hand, since the use of 69-kv should be retained as the transmission voltage in each plant because of its great advantage, the higher voltage of the interconnection would result in immediate installation of transformers at each end of the interconnection. Neither of these two results is desirable because of the cost involved. Furthermore, 69-kv is the preferred voltage for both the transmission system of each plant and for the interconnection because a stiff, closely coupled system will result.

*Numbers refer to bibliography at end of paper.

TABLE I

Current Rating Given by Various Authorities for 4/0, Stranded, Bare Copper Wire With 50 C Rise and With 1.4 Mphr Wind Given or Implied

	Location in reference	Temperature			Wind mphr	Current capacity
		Ambient	Conductor	Rise		
Frick[2]	Page 466	40 C	90 C	50 C	1.4	485
Wagner and Evans[3]*	Page 421	25 C	75 C	50 C	1.4	485
NEMA[4]	Page 29	40 C	70 C	30 C	....	385
To convert for 50 C rise as used by the other authorities listed here, reference[2] was used	.....	40 C	90 C	50 C	....	485
Zucker[5]	Page 504	40 C	90 C	50 C	1.4	485

*These data were checked by the authors with General Cable Corp., Anaconda Wire & Cable Co., and other companies. The values shown are repeated in Westinghouse Application Data 33-115, October, 1944, Page 12, Table X and in "Electric Transmission and Distribution Reference Book" by central station engineers of the Westinghouse Electric Corp., 1944, Page 30, Table I. The data of Frick[2] is based on reference. [6]

CONTINUOUS CAPACITY OF THE WIRE

The problem as presented indicated that the continuous current carrying capacity of the 4/0, 12-strand, bare copper wire of the existing 69-kv interconnection should be checked. This was done with the authorities listed in Table I.

The bases for Table I will now be discussed and applied solely to the problem at hand.

AMBIENT TEMPERATURE

In the data of the table the highest ambient temperature used is 40 C which is equivalent to 104 F. The maximum temperature reached in Chicago is 104.8 F or 40.0 C on July 24, 1934. This temperature was measured by the U. S. Weather Bureau at the Municipal Airport which is approximately 12 miles inland from one end of the line. It is an observed fact that temperatures at the lake shore are somewhat lower than inland temperatures. Therefore 40 C is a safe ambient to use as a basis.

SPEED OF WIND

A summary was made of the wind velocity at the Municipal Pier, approximately 11 miles north of the line, from 7:00 a.m. through 6:00 p.m., the warmest hours of the day, during July and August, the warmest months of the year, from 1946 through 1949, from observations of the Division of Water Purification of Chicago. It was found that winds of one and two mph have occurred only 1.7 per cent of the time; and, furthermore, except for four widely separated one-hour readings during the entire four-year period, these light winds occurred in the morning and late afternoon hours, the least warm of all the hours of the day.

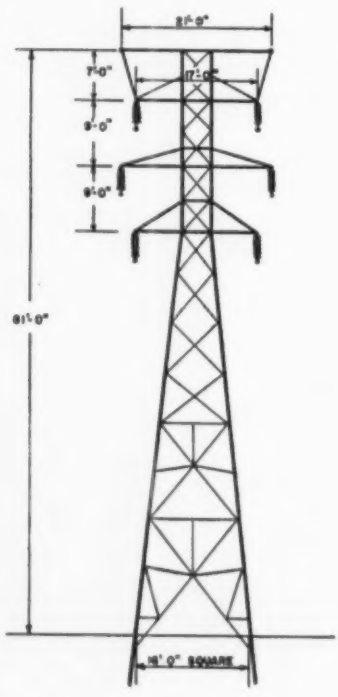

Figure 2 — Typical tower supporting the lines between the two steel plants.

The winds described have full opportunity to act on the line since nowhere are there obstructions to their free flow in any direction to the wires.

A wind of a speed not much more than the light value of Table I has a noticeable effect on the current carrying capacity of wire as shown by Figure 3 [7] and by Table II. As can be observed, an increase in wind from 1.4 to 5 mphr increases the current capacity by better than one-fourth.

TABLE II

Effect of Wind on Current Capacity of 4/0 Copper Wire, Based on Figure 3.

Wind mphr	Correction factor C.F.	Multiplier $= \frac{1}{C.F.}$	Current capacity = 382 x multiplier
0	1.00	1.00	382
1.4	0.79	1.27	485*
5.0	0.64	1.56	592
10.0	0.54	1.85	706
13.5	0.50	2.00	764

*Current capacity for 1.4 mphr wind is taken from Table I.

Tests [8] show that when 446 amperes is being carried by 4/0 stranded copper wire, the temperature rise is decreased one-third because of a small increase in wind: from 60 C at 1.4 mphr to 20 C at 5 mphr.

The effect of direction of the wind to the line can be ignored because of the conservative value of wind used in Table I, and the 10 C allowance between the maximum temperature rise of 90 C and the annealing temperature of 100 C discussed later.

COINCIDENCE OF HIGH AMBIENT AND LOW WIND

Maximum ambient temperature does not occur with low wind speed in the Chicago area from records of the U. S. Government Weather Bureau. The all-time maximum temperature of 104.8 F was accompanied by wind of 13 mphr with gusts up to 25 mphr. The second highest ambient of 102.9 F on July 21, 1901 had wind of approximately 17 mphr. The third highest temperature of 102.4 F on July 3, 1949 had winds of 10 mphr with gusts up to 15 mphr.

Further investigation of high temperature and wind combinations were not required because the conditions of Table I are fulfilled when proof has been secured that wind with a speed of at least approximately 1.4 mphr is present with maximum ambient of 40 C.

The meagerness of high temperature—low wind combination found in Chicago, Ill. corresponds to similar results found by previous studies of others in Detroit, Mich. [5]; Schenectady, N. Y. [6]; and Philadelphia, Pa. [9].

ANNEALING OF COPPER

The factor limiting the temperature rise of bare stranded copper is the annealing of the hard drawn

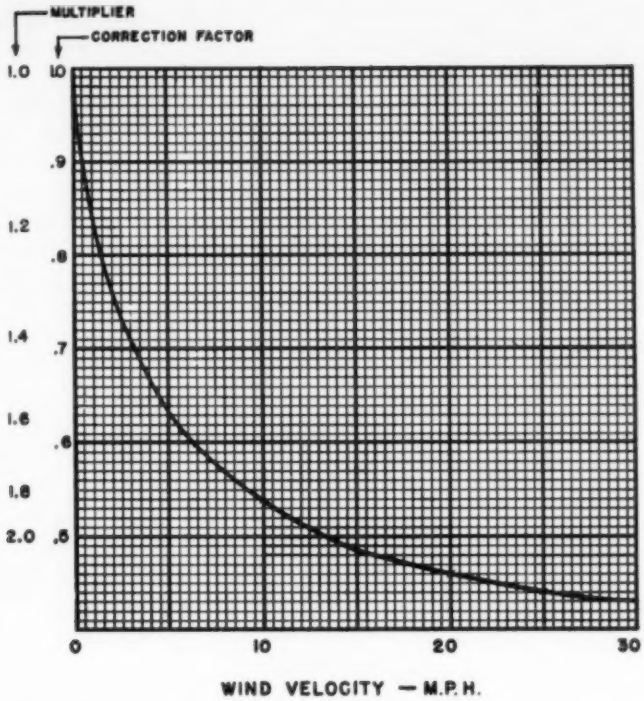

Figure 3 — Correction for cooling effect of wind. To secure possible increase in current due to effect of wind, multiply current at wind of 0 mph (calm) by multiplier corresponding to new wind speed taken from the above curve. For examples, see Table III.

strands. Since conductor stresses used in transmission line design are arranged to use the strength of hard drawn copper strands, annealing other than slight values must be prevented. As seen in Table III, annealing occurs at approximately 100 C or above. As shown in Table I, the maximum temperature used is 90 C, and, therefore, a conservative result is secured.

The most recent study of annealing was made to determine the effect of both heat and time on a grade of copper wire used for transmission lines [13]. As a basis for asserting when annealing occurs, the point where the wire loses five per cent of its strength was arbitrarily chosen. It is not claimed that the wire is unfit when such loss occurs. The tests also showed that annealing starts immediately at any temperature after the wire is placed in service, and that the annealing is cumulative. At temperature of 90 C when the wire is not under tension, it was found that the point of five per cent loss in strength occurs in approximately 1000 hours.

To allow for the tension applied in service, this time is reduced to 750 hours. Assuming a further 25 year life for the wire under discussion after it is placed in 60-cycle service, 750 hours is equivalent to 30 hours per year. This value is reduced one-half in order to allow for possible accumulated annealing at low temperatures. To equal the conditions of the study [13] there must be present during the warmest months of July and August, 15 hours of combined high temperature of 40 C and low wind of 1.4 mphr. As shown elsewhere, such combination rarely occurs.

The line is in existence. It would be difficult to justify replacing it by another on the premise that the conditions of the study [13] will soon render it unfit for use. Good engineering will assert that the practicable conditions described call for the line to be placed in service to carry the required current without harm. Furthermore, since future plans call for 60-cycle load at steel mill L and 60-cycle generators at steel mill R, the line will not be required to carry the full output of one generator continuously for many years.

In addition to the data of Table III and the preceding paragraph, there is available other evidence on the ability of 4/0 wire to carry the indicated current without being injured because of annealing. When the 69-kv line under discussion was completed in 1937, a two-circuit, 4/0, 22-kv line on concrete and steel poles, approximately 40 ft high, was dismantled on the same right of way. Records show that one 22-kv line has had a number of maximum high integrated kilowatt-hour readings per hour of 16,000 kwhr and swings during those hours up to 30,000 kw. The value of 16,000 kw is equivalent to approximately 440 amperes. At the time of dismantling, the wire was 32 years old and nowhere was there a sign of any annealing. On the basis of the foregoing description, there is justification in assuming that 4/0 wire on the new steel towers, which give height of 74 ft to the top conductor, will carry 485 amperes without harm.

TABLE III

Temperature at Which Annealing of Copper Wire Starts

Authority	Location in reference	Temperature at which annealing begins	Remarks
Kidder and Woodward[9]	Page 148	100 C	The assertion is made that it is uncertain whether copper begins to anneal at 100 C or 130 C.
Bureau of Standards[10]	Page 50, Figure 20	180 C	For electrolytic copper.
Bassett[11] . . .	Page 351	150 C	Based on tests.
Hoffman and Hayward [12]	Page 6	100 C	See curve referred to.

EFFECT OF SUN

The effect of the sun shining on a loaded bare conductor is negligible, as proved by tests [6], and because of the conservative value of minimum wind listed in Table I. At the worst the solar radiation onto the surface of the wire, without the effect of wind, reduces the load by 1.8 to 2.2 per cent [9], a very small value and no worse than the accuracy of the figures used. Even if the small temperature increase due to the sun is considered, it is cancelled out by a very light wind. For example, while on 4/0 wire a temperature increase of 20 C decreases the current capacity by approximately 12 per cent, an increase in wind from calm to one mphr will increase the capacity by one-third [5].

OTHER CONSIDERATIONS

When the line is placed in 60-cycle service, completely new modern substations will have been installed at each end, and therefore adequate current carrying capacity of the substation equipment, correct relaying, and proper lightning protection will be available.

Plans have been made that before the line is placed in service the entire line equipment will be inspected and defective wire, insulators and fittings replaced if required.

Checks of the spans of the line show that the 90 C temperature will not cause sags which will be harmful, since during the design of the line, clearances were increased over the minimum for safety and the increased sags will not use all of this safety factor.

The money value of the capitalized line losses incurred by the high current plus the installed cost of that part of the generating capacity used to supply the line losses does exist, but is insufficient to justify a new larger line to reduce the losses. It should be kept in mind that a steel mill deals with electric power as a means to achieve its prime purpose to produce steel and not as an end in itself.

With the wire operating at temperature of 90 C, it can be safely claimed that the problem of ice forming during cold weather is not existent.

EFFECT OF FAULT CURRENT

It can be claimed that the imposition of fault current upon the wire after it has reached its maximum temperature when carrying load current would further heat it and damage the wire by annealing. The temperature rise due to fault current was calculated using 1,500,000 fault kva and selective pole breakers, both determined by the network calculator studies previously mentioned [1]. Assuming the worst condition that all of the resultant heating of the fault current would be stored in the wire, it was found that the temperature rise was less than 5 C.

On the assumption that annealing occurs at 100 C, there is a 10 C allowance, previously described, over and above the ultimate temperature of 90 C of Table I. Furthermore, annealing of wire will not occur instantaneously but only after it has been subjected to heat for many hours [13]. Therefore, damage will not occur when a fault occurs after the wire has reached maximum temperature due to load current.

CAPACITY OF LINE

The matter to this point has proved that the basis of Table I is correct for the case under discussion, and, therefore, the data can be used with complete confidence to determine the capacity of the line being considered.

Inspection of Table I will show that all of the quoted authorities agree on 485 amperes as the continuous current carrying capacity of 4/0 bare stranded copper wire under the conditions listed which are more restrictive than those actually existing. At the nominal voltage of 66 kv and power factor of 95 per cent which can be easily attained at the load, the continuous rating of the line is 52,000 kw.

The value of 52,000 kw is sufficient for the requirements of the 60-cycle load of steel mill R. If a few thousand more kilowatts are available at the generator of steel mill L and can be used at steel mill R, they can be transmitted without harming the copper of the line, since the error involved is small, at least no greater than the error inherent in the figures used. Since the studies [1] on the network calculator showed that the voltage of steel mill R will be nearly always higher than the assumed 66 kv and the power factor can be made close to unity, fears that the line would not carry the full output of the generator are groundless. Furthermore, such carrying of full capacity by the line is in accord with the current trend toward high circuit loading as one of the most effective ways to reduce the cost of transmitting energy by making maximum use of available facilities.

CONCLUSIONS

With the worst condition of highest ambient temperature and light wind, the single 4/0 stranded copper wire line can carry to one steel mill, without possibility of annealing, the full output of the generator at the other steel mill.

The values of Table I can be used anywhere under any conditions, if allowance is made for ambient temperatures higher than those considered and for increased intensity of solar radiation if and when studies show they exist.

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PROGRAM

ANNUAL SPRING CONFERENCE

SPONSORED BY THE ROLLING MILL COMMITTEE OF

ASSOCIATION OF IRON AND STEEL ENGINEERS

TUTWILER HOTEL

BIRMINGHAM, ALABAMA

APRIL 3 and 4, 1950

An Invitation . . .

. . . operators and engineers in the steel industry will find it worthwhile to attend the Annual Spring Conference of the Association of Iron and Steel Engineers. This meeting features papers covering some important technical developments in the steel industry, and specifically emphasizes practices in such basic items of steel production as blooming mills, rod mills, blast furnaces and annealing furnaces. The steady, although perhaps not spectacular, developments in these fields offer appreciable possibilities for production economies.

We hope that you will be able to attend and take advantage of this meeting.

A. S. GLOSSBRENNER

President, AISE

Annual Spring Conference Program

ROY W. SCHOLL

D. W. LLOYD

I. H. MIDDLETON

MONDAY, APRIL 3, 1950

9:00 a.m. — Registration — Mezzanine Floor, Tutwiler Hotel

9:15 a.m. — Rolling Mill Session — Terrace Room

Co-Chairmen:
Charles P. Hammond
Rotary Electric Steel Co.

J. W. Johnson
Tennessee Coal, Iron and Railroad Co.

1. "Billet Size Ingot Practice"
   Roy W. Scholl, Assistant to the Executive Vice President
   Connors Steel Co.

2. "Modern Blooming Mill Practices"
   D. W. Lloyd, General Superintendent
   Brier Hill Works
   Youngstown Sheet and Tube Co.

3. "Manufacture of Electric Fusion Welded Pipe"
   J. H. Middleton, Chief Metallurgist, Southern District
   Republic Steel Corp.

9:15 a.m. — Technical Session — Colonial Room

Co-Chairmen:
E. A. Hawk
Tennessee Coal, Iron and Railroad Co.

Walter Nielsen
Sloss-Sheffield Steel and Iron Co.

1. "Underground Coal Gasification at Gorgas"
   Milton H. Fies, Consulting Engineer

2. "Technical Aspects of Northern and Southern Blast Furnace Practice"
   C. G. Hogberg, Assistant to Chairman of Blast Furnace Committee
   United States Steel Corp. of Delaware

3. "Some Aspects of Annealing Atmospheres Used in the United States for Tinplate Strip"
   James R. Trimble, Assistant Manager
   Department of Metallurgy, Inspection and Research
   and
   J. Ernest Hill, Metallurgical Engineer, Sheet and Tin Mills
   Tennessee Coal, Iron and Railroad Co.

1:30 p.m. — Buses leave the Tutwiler Hotel for Inspection Trip to Connors Steel Co.

7:00 p.m. — Dinner — Terrace Room

Speaker: Clayton Rand, Gulfport, Miss.

MILTON H. FIES

C. G. HOGBERG

J. ERNEST HILL

A. F. EISEL

TUESDAY, APRIL 4, 1950

9:00 a.m. — Rolling Mill Session — Terrace Room

Co-Chairmen:
J. N. Imel
Jones and Laughlin Steel Corp.

R. M. Lang
Atlantic Steel Co.

1. "Recent Developments in Blooming, Bar and Billet Mills"
   A. F. Eisel, Chief Roll Designer
   United Engineering and Foundry Co.
2. "Roller Guides"
   Clark Lambert, Superintendent of Merchant Mills, Campbell Works
   Youngstown Sheet and Tube Co.
3. "19-Stand Rod Mill of Keystone Steel and Wire Co."
   Wm. Herman, Superintendent, Rolling Mills
   Keystone Steel & Wire Co.

CLARK LAMBERT

9:00 a.m. — Technical Session — Colonial Room

Co-Chairmen:
Eric Anderson
Bethlehem Steel Co.

Alex Henry
Tennessee Coal, Iron and Railroad Co.

1. "The Blooming Mill — Steel Industry's Iron Horse"
   Ralph H. Wright, Steel Mill and Metal Working Section
   Westinghouse Electric Corp.
2. "Developments in the Design of D-C Motors and Generators for Rolling Mills"
   B. H. Caldwell, Jr., Section Engineer, Large D-c Motors and Generators
   General Electric Co.
3. "Continuous Cascade Pickling"
   W. H. Stuck, Metallurgical Investigator
   Jones and Laughlin Steel Corp.
   and
   J. H. Abrams, Technical Representative
   American Chemical Paint Co.

WM. HERMAN

1:00 p.m. — Buses leave the Tutwiler Hotel for Inspection Trip to strip mills, and tin mill at Fairfield Works, Tennessee Coal, Iron and Railroad Co.

RALPH H. WRIGHT

B. H. CALDWELL, JR.

W. H. STUCK

J. H. ABRAMS

Inspection Trips

CONNORS STEEL CO.

BIRMINGHAM, ALABAMA

MONDAY, APRIL 3, 1950

1:30 P. M.

Buses leave the Tutwiler Hotel for an inspection trip to the Connors Steel Co.

This plant features a number of unusual practices which will be of particular interest to rolling mill men.

▲

TENNESSEE COAL, IRON AND RAILROAD CO.

FAIRFIELD WORKS

FAIRFIELD, ALABAMA

TUESDAY, APRIL 4, 1950

1:00 P. M.

Buses leave Tutwiler Hotel for Inspection Trip through the strip and tin mill at the Fairfield Works of the Tennessee Coal, Iron and Railroad Co.

This plant has incorporated many new developments in equipment which has been installed since the war and in modernization of their older equipment. These changes are of interest to the industry.

▲

Special Inspection Trips

Arrangements have been made by which special trips may be made to a number of plants in the Birmingham area. Some of these trips undoubtedly will be of interest to the operators attending the Spring Conference. Among the plants who have indicated their willingness to have visitors are the Atlantic Steel Co., Atlanta, Ga.; Woodward Iron Co., Woodward, Ala.; and the American Cast Iron Pipe Co., Birmingham, Ala. Arrangements for these trips and perhaps others can be made for April 5th or 6th. For further details check in at the registration desk.

FUTURE ORE SUPPLIES

. . . . the following comments on future ore supplies are excerpted from a statement made before the Congressional Joint Committee on the Economic Report in Washington, D. C. on January 24, 1950 . . . .

By JOHN C. MUNSON
Vice President, Raw Materials
United States Steel Corp. of Delaware
Pittsburgh, Pa.

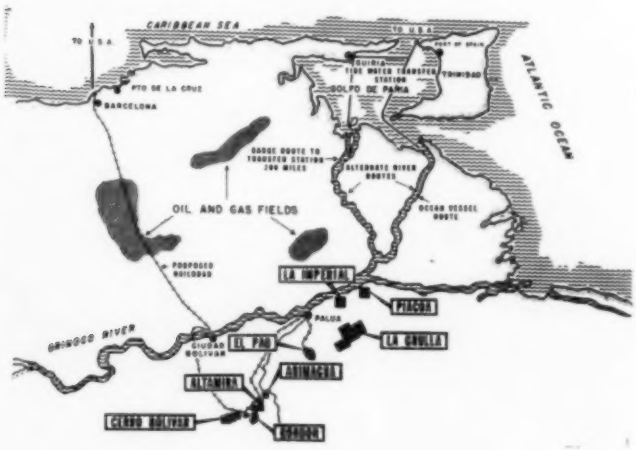
▲ ONE extremely serious problem confronting the steel industry is brought about by the dwindling supply of high grade iron ore in the United States. Since the early 1900's over 80 per cent of the nation's iron ore supply came from the Lake Superior district. Most of these ores were shipped in their natural state, supplemented by concentrates from simple beneficiating processes. The drain on these reserves caused by the fighting of two World Wars, as well as peacetime uses, has depleted them to a point where some experts say that in the not too distant future—in terms of the life of the steel industry—these reserves may be unable to fully meet the nation's demand for ore.

Individual steel companies are attacking this problem on two fronts, ever mindful that our security in times of emergency rests primarily on the beneficiation of low grade taconite ores which are abundantly available within the borders of our own country.

Since the use of the taconite ores will result in higher cost, United States Steel and other consumers of ore deemed it essential to examine ore deposits in many foreign countries to ascertain whether or not such ores can be used economically at our present consuming plants.

Iron ore is not a scarce mineral, for large deposits are well scattered throughout the world. Most of this ore, however, is so located that it would be uneconomic to use it in the United States.

Figure 1 — Iron ore concessions in Eastern Venezuela.

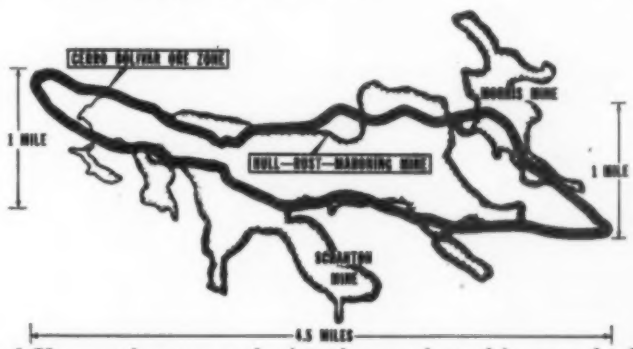


Since 1945 exploratory parties sent by U. S. Steel have visited Africa, Canada, Mexico, Cuba, Nicaragua, Venezuela, and other countries. Explorations of many of these areas proved not only costly but futile. However, two outstandingly large deposits of iron ore have been discovered which can be economically developed. One is the well-publicized field in Labrador known as the Hollinger-Hanna Concession, the other is the Venezuelan deposits discovered by our geologists, shown in Figure 1.

Eastern Venezuela was explored in the late 1920's and certain deposits of high grade ore were found, then believed to approximate 50-75 million tons. This reserve was obtained by another steel corporation, which is now developing it.

West of the Caroni River was a vast unexplored land. From a study of the general topography of this part

Figure 2 — Comparative areas, Hull-Rust-Mahoning group open pit iron mine, Hibbing, Minn. and Cerro Bolivar Iron-Bearing Zone, Venezuela.



of Venezuela our geologists knew that this area had been subjected to violent upheavals in the geological ages; they also knew that the possibilities were favorable for finding iron ore in the hills and mountains formed by these upheavals. Our company, after formal approval of the Venezuelan government, made an aerial survey and photographed 10,500 square miles of this territory. Objectives, pinpointed on these photographs, after a study of the terrain, were examined by exploration parties traveling in planes, jeeps, and on foot. Magnetometer surveys showed strong magnetic indications in the areas of iron ore occurrences discovered by these parties. Diamond drills were hurried into the country to see if the magnetic indications were caused by a large deposit of high grade iron ore or by a

low grade highly magnetic formation. Exploration tunnels were driven into the side of the Cerro Bolivar Mountain. From information derived from drilled samples and samples obtained from the tunnels, we knew we had found a large quantity of iron ore.

Recently a new subsidiary of United States Steel Corp. was organized, the Orinoco Mining Co., to undertake the development of this ore property in Venezuela. Our problem in Venezuela does not concern quantity or quality of ore but is one of financing the development of the property itself and determining the best methods to be used in bringing the ore from the interior to the ocean shipping points.

Some idea of the size of the largest Venezuelan de-

Figure 3 — Water and land transportation routes from Venezuela, Labrador-Quebec, and Lake Superior Districts to United States furnaces.

posit known as Cerro Bolivar can be obtained by superimposing its linear dimensions on the outline of the famous Hull-Rust Mine of the Mesabi Range (Figure 2) from which the iron ore was obtained to win two World Wars.

Our discoveries in Venezuela are of sufficient size and quality to affect materially the iron ore supply of this country. As these Venezuelan deposits are developed to supplement our present domestic reserves, they will aid in assuring that there will be adequate competition in the future between iron ore from various sources, and they will also conserve our natural high grade domestic ores, thus increasing the security of this nation and our good neighbors to the south.

Taconite, of which the Lake Superior iron ranges were formed, is an iron formation, about one-third iron and two-thirds waste. The taconite of the Mesabi Range, the largest of the deposits, stretches across northern Minnesota in a solid formation, a hundred miles long and several miles wide. Sprinkled here and there, like raisins in a cake, are the ore pockets from

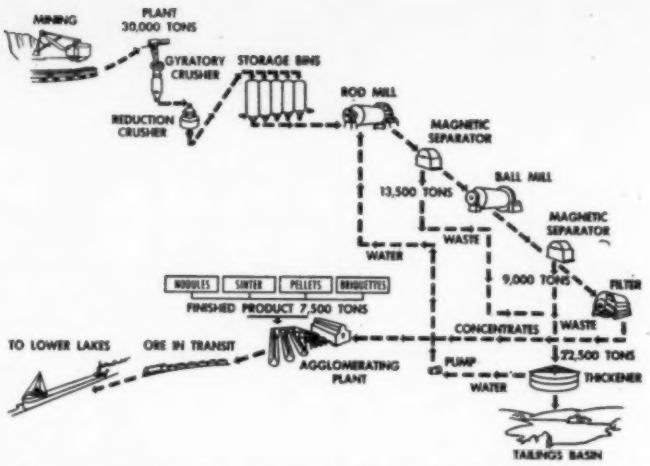


Figure 4 — Typical magnetic concentration process for taconite.

which the present high grade ores are being mined.

The hard solid taconite iron formations, after the layer of glacial drift has been removed, will be quarried, taken to beneficiation plants for crushing and grinding to powder fineness. From every four tons of this powder, one ton of good usable iron ore will be recovered. This fine grade ore will then be reconstituted for furnace use into lumps, or pellets, analyzing about 60 per cent iron. (Figure 4). It is evident that "manufactured" iron ore produced by this process results in a higher cost product as compared to the cost of today's readily mined high grade ore.

Much must be accomplished before we can start producing taconite ore in commercial quantities. Taconite

Figure 5 — Cerro Bolivar is a mountain of iron ore recently acquired in Venezuela by United States Steel. It is expected that such ore will eventually be used to supply some of the present steel mills of United States Steel, as well as the needs of other users of ore. Quality of the Venezuela ore is higher than that now being mined in the Lake Superior district. It is estimated that the mountain will yield sufficient ore to meet a large annual demand in the United States for several decades.

concentration processes already have been developed for separating the magnetic portions of iron from the finely powdered taconite. A large laboratory has been installed by U. S. Steel in Duluth and our research engineers are continuing their costly studies to determine methods of recovering the hematite or non-magnetic portions of iron contained in the taconite rock.

We must continue an extensive drilling program to locate the taconite areas most favorable to concentration. Pilot plants must be erected to insure that the processes developed for concentrating the ore are the most economical possible, in order that the end price of a ton of steel will carry the minimum burden of high ore cost.

Now each of these beneficiating processes presents technical problems and this solution costs money. Estimates of the taconite concentration program place the capital investment at approximately $15 to $20 per annual ton of iron ore produced. In other words, if the steel industry were to replace the present Lake Superior natural ore supply with a taconite supply alone, it would be faced with a capital investment in iron ore facilities of between 1¼ and 1¾ billion dollars at today's prices.

In planning a comprehensive iron ore program to follow for the next twenty or more years, we now face the prospect of shrinking domestic reserves of natural ores on the one hand and the large capital investments and operating costs of developing a foreign ore and domestic taconite problem on the other. It is the aim of the corporation to so plan its development program that the minimum cost increase for iron ore will be necessary as the new sources are developed, while at the same time the maximum amount of "readily minable" domestic natural ores is conserved for use during periods of national emergency.

You Will See...

EVERYTHING NEW FOR THE STEEL INDUSTRY

- NEW IDEAS
- NEW METHODS
- NEW DEVELOPMENTS
- NEW PROCESSES
- NEW EQUIPMENT
- NEW APPLICATIONS

AT THE 1950 IRON AND STEEL EXPOSITION

Held in conjunction with the Annual Convention of the Association of Iron and Steel Engineers.

CLEVELAND, OHIO -- September 26-27-28-29

Report of Activities

OF AISE STANDARDIZATION COMMITTEE - 1949

By FRANK W. CRAMER

Chairman* AISE Standardization Committee

▲ DURING the year 1949 the various sub-committees of the Association of Iron and Steel Engineers Standardization Committee continued their work and made a great deal of progress. Several of the projects of the Association of Iron and Steel Engineers were carried through to adopted standards.

Of the projects still under way, activity is centered in the following.

1. Plain Bearings.
2. Handbook of Lubrication Standards for the Steel Industry.
3. Fuel, Furnace, Control and Ceramic Handbook.
4. Flexible and Solid Couplings.
5. Size, Length, Breadth and Types of Shunting for Motor Brushes.
6. Content and Amount of Dirt in Steel Mill Atmospheres.
7. Steel Mill Lighting.
8. Crane Wiring.
9. Crane Limit Switches.
10. Rolling Pressures and Power Requirements for Rolling Mills.
11. Mill Motor Brake Standardization.

One of the biggest achievements of the Association was the final adoption of a new revised Association of Iron and Steel Engineers' "Specifications for Electric Overhead Traveling Cranes for Steel Mill Service." This project has now been assigned a standard number and is called AISE Standard No. 6. The final edition of this standard was adopted by the Board of Directors on May 1, 1949. The content is in general as reported at this meeting last year. The standard was published in the July 1949, issue of the Iron and Steel Engineer and will also appear in the 1949 yearbook of the AISE. Printed copies of the standard may also be purchased from the headquarters of the AISE. It is very gratifying to note that this standard has been widely adopted throughout the United States, and also that calls are being received for it from all parts of the world. The committee who carried out this project are to be commended for their work.

Another standard which has been carried through and approved by the various committees is AISE Standard No. 7, "Specifications for the Design of Ladle Hooks." This specification received its final approval at the Board of Directors meeting which took place October 2, 1949. William H. Mursch, chairman of the committee on design of ladle hooks, will give a more detailed report on this subject. I might say, however, that although the standard is based on the research work done on hooks by the Association at the Carnegie Institute of Technology, and although the specification in general is in accord with the results of this research work, the thing that was difficult to finally settle on was the maximum allowable stress to be used in design. Normally, we have thought that hook stresses were in a range up to a maximum of about 6000 psi. However, from the actual values which were measured and which can be computed if all items are taken into account, the actual stresses are more than double this figure. This may also be the reason for some of the troubles with hooks which are normally attributed to abuse. It was finally decided to use a design figure of 12,000 psi, and incidentally the selection of this figure depends on judgment, because it is impossible to select a value which is as low as one might like. The reason that the value cannot be set much lower is that the maximum width of the hook upon which the sidewise stresses are largely dependent is limited by the clearance on the ladle trunnion. However, Mr. Mursch will go into this more fully.

Incidentally, it may be advisable at this time to review procedure by which the various standards are adopted: A draft of the standard is developed and approved by the sub-committee which is handling a particular project. The standard is next gone over and approved by the AISE Standardization Committee. After approval by the Standardization Committee, it finally goes to the Board of Directors for their final approval as an adopted AISE standard. In some cases they may be adopted as tentative standards which will take effect in one year provided usage during that year brings out no strong reasons for changing or revising these standards.

During the past year the committee has also been working on the formulation of a design standard for hot metal ladles. The research work on this project was completed over a year ago at Lehigh University, and reported on at last year's convention. The research work was directed at trunnion and ring behavior on the hot metal ladles. The design of the plate in the shell itself was not covered by the experimental stress analysis, inasmuch as the Boiler Code Committee of the ASME is sponsoring a good deal of work on the subject of unfired pressure vessels. Inasmuch as the problem of the plate stresses in ladles is similar to the ASME problem, the AISE decided that there was no point in duplicating this work. However, the problem is so complex that results of the research work of the ASME so far cannot be easily applied to a hot metal ladle standard. Therefore, the committee has written up a hot metal ladle standard which is based on the research work sponsored by the AISE covering all the details of

* The chairman for the 1950 AISE Standardization Committee is L. J. Gould, Chief Engineer of Construction, Bethlehem Steel Co., Bethlehem, Pa.

the ladle, except the thickness of the bottom and sides. The committee has not decided, however, whether it should set up empirical formulae or tables to cover these plate thicknesses, or whether it should wait until a later date when the pressure vessel program may be far enough along to offer a rational basis for the plate specifications.

Progress was made by the plain bearings committee during the year and the committee has drafted a tentative design procedure for plain bearings. This procedure has not been passed on to the Standardization Committee, but it is believed that this work will be completed this year, and the results will offer a general guide to the proper selection of bearings and their proportions.

During the year the Association completed its collection of data on flexible and solid couplings, and various designs are now being studied to determine whether standardization is feasible on flexible couplings.

Hugh Conover, chairman of the sub-committee on carbon brushes will report on "Carbon Brush Standardization." Mr. Conover has accomplished a great deal on this program and he has developed and will offer you a proposed standard which will cover brushes for mill motors. This has also been submitted to the motor manufacturers. This is only one phase of the complete program, but the more important part as far as steel plants are concerned. If the brushes cannot be standardized for mill motors, it is rather improbable that we can succeed on the overall basis.

Nothing was accomplished during the year on the program of "Content and Amount of Dirt in Steel Mill Atmospheres." This particular program, because of many factors, seems to lie in a hush-hush atmosphere. Unfortunately, few people seem to know much about the subject and what is known is not disseminated too widely. The program is with us, however, and with present regulatory trends, it will have to be solved sooner or later, and if too late, the initiative and control may be taken out of our hands. This project was developed primarily to obtain data on how much dirt was in the atmosphere in the various departments of steel plants. Such data is required to design various types of air cleaning and conditioning equipment required in plant processes. This project was in turn expanded (primarily on a discussion level) to a project on determining how much dirt is emitted in the various segments of the steel plant and how such emission can be controlled. It may be that we would have better success on this project if we reduce the scope to its original content and accordingly I would like to have some of your expressions and opinions at this meeting on such a change or reduction.

Our work on "Steel Mill Lighting" consists primarily of assistance and liaison with the Illuminating Engineering Society in their overall program to develop a code on lighting for industrial plants. Our work consists of helping them develop standards for steel plants, and at the present time the general committee is in the process of approving lighting standard for the open hearth.

C. G. Dimitt, one of the co-chairman of the AISE Crane Wiring Standardization Committee, will report on their work on crane wiring. This committee, under Mr. Dimitt and Mr. Bodoh, have done a magnificent job in preparing a wiring standard which will give a rational basis for selecting the most economical wire with sufficient capacity for satisfactory use on cranes in steel mill service. They are planning to propose that their standard be adopted on a tentative basis for a year and then finally adopted unless something develops during the year which would make revisions advisable. Because of the value of this work it was proposed at the Standardization Committee meeting to expand the scope of this project to all steel mill wiring, and the completion of such a project would be of great value to the industry.

The committee on "Rolling Pressures and Power Requirements for Rolling Mills" continued with the collection of data on this subject.

V. E. Schlossberg, chairman of the joint AISE-NEMA committee on "Brake Standardization," will report progress on their standardization work during this past year.

At this time I would also like to report that new 600 series mill motor which was adopted as AISE Standard No. 1 in September 1947, has met with practically unanimous approval throughout the steel industry. In 1948, about 85 per cent of all the mill motors ordered were in the 600 series, and in the first eight months of 1949 over 90 per cent of sales have been for the 600 series. Actually, the percentage used in the steel industry is still higher as the shovel manufacturers are also large users of mill motors and the majority of orders for the old motors have been for the shovel manufacturers who use them in their standard shovel designs. The shovel manufacturers, however, as they bring out their new models are adopting the 600 series motor when they design a new shovel model.

One subject which still raises some discussion and criticism was the elimination of the half hour rating in the AISE Mill Motor Standard. However, this has caused less trouble than was expected and is also leading to the more logical design procedure that motor application should be based directly on the data given by motor characteristic curves, for the load for which the motor is being worked, rather than on any arbitrary ratings. This procedure was adopted in the new motor selection sections of the AISE Specifications for Electric Overhead Traveling Cranes.

One other criticism has also been raised on the new 600 series mill motor standard. This is that the counterbore dimension WD on the coupling for the 608 frame and larger is too small, and that it is difficult to get a wrench whose outside diameter is small enough to set in the counterbore when turning the nuts. If this is the case, it is believed that a revision should be made on these AISE standard dimensions. However, such difficulty will vary with the wrenches which are used. It may be that some wrenches require much more clearance than others. Therefore, we would like comments from any one who may have run into this problem, giving us details on their difficulties and also details on whether they have found wrenches which will satisfactorily handle the job. It is our opinion that if the problem only occurs with off-standard wrenches, we should not change the mill motor standard, but if the problem occurs with practically all wrenches, then we should change our mill motor standard.

AISE *Carbon Brush Standardization*

By HUGH CONOVER

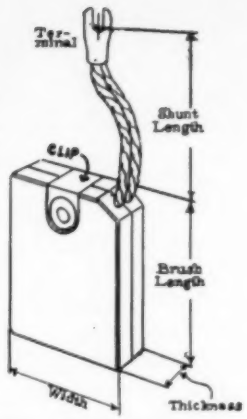
Chairman*, Sub-Committee on Size, Length, Breadth and Type of Shunting for Motor Brushes

A. I. S. E.
CARBON BRUSH STANDARDS

A.I.S.E. CODE NUMBER	BRUSH SIZE (Inches) Length	Width	Thickness
39	2-1/2	1-1/2	3/4 SPLIT

SHUNT
(Tinned)

Connection R - BE Position 8 - 8
Clip Type and Width "A" - 3/4"
Length 5-1/2" Terminal 5 - 9



MOTOR MANUFACTURER	MOTOR TYPE	MOTOR FRAME NUMBERS
GENERAL ELECTRIC	MD	418
WESTINGHOUSE	MC	612, 614
CROCKER-WHEELER	W	612

Figure 1 — This is a typical suggested standard brush. This brush appears as item No. 57 and Standard No. 39 on Table I.

This is a progress report, because these standards which the committee suggests have not been approved by committee action. We had a meeting with motor manufacturers' representatives and submitted the standards to them; at first look they said they were very good. They took the standards back with them for review by their engineering departments and, no doubt, some compromises will be necessary before they are finally approved by the motor manufacturers. They will then be submitted to the brush manufacturers and the users of the motor for their approval.

We have had quite an interesting time developing these standards. We asked all the steel companies to submit a list of brushes that they were using, and the way they were ordering them. We received lists from five companies, but we find interestingly enough in going over these lists, that one company had already standardized their own brushes. We also find that one plant, and this is just an example, ordered brushes for one mill type motor in twenty-one different ways—that is, with twenty-one variations.

This results in a large number of orders for the same brush which is a hardship for the brush manufacturers, and also results in brush orders of 25 or 50 in most cases, which bring very small discounts.

If you can standardize the brushes, then instead of ordering 25 or 50, and receiving small discounts, you can order hundreds or thousands, and receive large discounts, the total brushes ordered yearly being the same. As you know, the brush discounts, which are published, go up to 53 per cent.

One of our difficulties was that we had no standards for most of the attachments on the brushes, such as the terminal, plate, and where the shunt was brought out, so the first thing we had to do was secure standards from NEMA.

Some mills have been ordering tinned shunts, and others untinned. We are recommending that all shunts be tinned to save confusion.

We then consolidated the different orders, using a standard terminal, as few lengths of shunts as possible, a standard position for the shunts, and the

*1950 Carbon Brush Committee chairman is Eric Anderson, Electrical Superintendent, Bethlehem Steel Co., Johnstown, Pa.

TABLE I — SUGGESTED CARBON BRUSH STANDARDS FOR MILL MOTORS

No.	Present brush size, in.	Split S	115-v Motors	230-v Motors	550-v Motors	Suggested Std. No.	Brush size, in.	Connection	Shunt length	Terminal
1	1/4 x 1 1/4 x 1 1/2			K1, KG1		1	1/4 x 1 1/4 x 1 1/2	RA2-BE	3 1/2	S7
2	5/16 x 3/4 x 1 5/8				MD101	2	5/16 x 3/4 x 1 3/4	RA2-BE	3 1/2	S7
3	5/16 x 1 1/4 x 1 5/8				MD102	3	5/16 x 1 1/4 x 1 3/4	RA2-BE	3 1/2	S7
4	3/8 x 3/4 x 1 3/4			MD402	MD402, 403	4	3/8 x 3/4 x 1 3/4	RA2-BE	3 1/2	S7
5	3/8 x 7/8 x 2 5/16			SW7 1/2	KWS5	5	3/8 x 7/8 x 2 1/2	RA2-BE	5 1/2	S9
6	3/8 x 1 x 1 5/8			MD102	MD103					
7	3/8 x 1 x 1 3/4			MC602		6	3/8 x 1 x 2	RA2-BE	3 1/2	S9
8	3/8 x 1 x 2				MD404, 406					
9	3/8 x 1 1/8 x 1 3/4			6MW		7	3/8 x 1 1/8 x 1 3/4	RA2-BE	5 1/2	S9
10	3/8 x 1 1/4 x 1 1/2			K2, KG2						
11	3/8 x 1 1/4 x 1 3/4			MC2, 21, 603	MD602	8	3/8 x 1 1/4 x 2	RA2-BE	3 1/2	S9
12	3/8 x 1 1/4 x 2 1/4				MD407					
13	3/8 x 1 1/2 x 2				K3, 4, KG3, 4	9	3/8 x 1 1/2 x 2	RA2-BE	3 1/2	S7
14	3/8 x 1 3/4 x 2			MC3, 4, 31, 41	MC3, 31, K5, KG5	10	3/8 x 1 3/4 x 2	RA2-BE	4 1/2	S7
15	3/8 x 2 x 2			K6, KG6	K6, KG6	11	3/8 x 2 x 2	RA2-BE	4 1/2	S7
16	3/8 x 2 3/8 x 2				K8, KG8	12	3/8 x 2 3/8 x 2	RA2-BE	4 1/2	S7
17	7/16 x 3/4 x 1 5/8			MD101		13	7/16 x 3/4 x 1 3/4	RA2-BE	3 1/2	S7
18	7/16 x 1 1/4 x 2		MD101		MD104	14	7/16 x 1 1/4 x 2	RA2-BE	3 1/2	S9

TABLE I — SUGGESTED CARBON BRUSH STANDARDS FOR MILL MOTORS — Continued

No.	Present brush size, in.	Split S	115-v Motors	230-v Motors	550-v Motors	Suggested Std. No.	Suggested Brush size, in.	Suggested Connection	Suggested Shunt length	Suggested Terminal
19	½ x ¾ x 1¾			MD403, 602, 603	MD603, 604	15	½ x ¾ x 1¾	RA2-BE	3½	S7
20	½ x ⅞ x 2 5/16			SW10	KWS10	16	½ x ⅞ x 2½	RA2-BE	5½	S9
21	½ x 1 x 2			MD404, 406, 604	MD606	17	½ x 1 x 2¼	RA2-BE	3½	S9
22	½ x 1 x 2¼			MC604						
23	½ x 1⅛ x 2			AW, 10I, IF, BW, 1SIF		18	½ x 1⅛ x 2⅜	RA2-BE	5½	S9
24	½ x 1⅛ x 2 5/16			SW15						
25	½ x 1¼ x 1⅝		MD103	MD103	MD104½	19	½ x 1¼ x 2¼	RA2-BE	5½	S9
26	½ x 1¼ x 2¼				MD105, 107, 108, 109					
27	½ x 1⅜ x 1⅝		MD102			20	½ x 1⅜ x 1¾	RA2-BE	3½	S7
28	½ x 1½ x 2			K3, KG3						
29	½ x 1½ x 2¼			MT000, MC6, 20, 40, 61	MC14, 40, 50, 60, 70, 81, 101, 141, MD408	21	½ x 1½ x 2¾	RA2-BE	5½	S9
30	½ x 1½ x 2½			MC616, 618						
31	½ x 1½ x 2¾			K9, KG9	38B, 47, 47A, 47J, 49, 49D, 52, K9, KG9					
32	½ x 1⅝ x 2 5/16				KWS25	22	½ x 1⅝ x 2½	RA2-BE	5½	S9
33	½ x 1¾ x 2¼			MC30	MC30, 90, K10, KG10					
34	½ x 2 x 2¼				MD-410, 412, 414, 416 K7, KG7	23	½ x 1¾ x 2¼	RA2-BE	5½	S9
35	½ x 2 x 2 5/16			EW	KWS75	24	½ x 2 x 2½	RA2-BE	5½	S9
36	½ x 2 x 2½				MC80, 100					
37	½ x 2½ x 2 5/16			IW		25	½ x 2½ x 2½	RA2-BE	5½	S9
38	⅝ x 1¼ x 2¼	S		MD606	MD608	26	⅝ x 1¼ x 2½	RA8-8BE	5½	S9
39	⅝ x 1¼ x 2¼		MD404	MD105, 407, MC-606	MD106, 109½	27	⅝ x 1¼ x 2½	RA2-BE	5½	S9
40	⅝ x 1⅜ x 2¼	S	MD606			28	⅝ x 1⅜ x 2¼	RA8-8BE	4½	S9
41	⅝ x 1½ x 1⅝		MD104							
42	⅝ x 1½ x 2			MD104, MC8, 81, K4, KG4	MC12, 21	29	⅝ x 1½ x 2¼	RA2-BE	5½	S9
43	⅝ x 1½ x 2¼		MD 406, 408	MD408, 412, W-610	MD418					
44	⅝ x 1½ x 2¼	S		MD416, 610, 614	MD420, 421, 616, 618	30	⅝ x 1½ x 2¼	RA8-8BE	5½	S9
45	⅝ x 1⅝ x 2¼				12W50	31	⅝ x 1⅝ x 2½	RA2-BE	5½	S9
46	⅝ x 1⅝ x 2 5/16			DW, CW, SW50						
47	⅝ x 1¾ x 2			K5, KG5		32	⅝ x 1¾ x 2¼	RA2-BE	5½	S9
48	⅝ x 1¾ x 2¼			MC50, 608						
49	⅝ x 1¾ x 2¼	S		MD410, 608, MC-50, 608	MD610, 612, 614	33	⅝ x 1¾ x 2¼	RA8-8BE	5½	S9
50	⅝ x 2 x 2 5/16			SW100		34	⅝ x 2 x 2½	RA2-BE	5½	S9
51	⅝ x 2 x 2½			50D, 50DA						
52	⅝ x 2½ x 2 5/16			IW, HW		35	⅝ x 2½ x 2½	RA2-8BE	5½	S9
53	¾ x 1⅛ x 1⅝			MD104½		36	¾ x 1⅛ x 1¾	RA2-BE	3½	S7
54	¾ x 1¼ x 2¼				MD110	37	¾ x 1¼ x 2¼	RA2-BE	5½	S9
55	¾ x 1½ x 2¼			MT00, 0, MC12, 60, 101, 121		38	¾ x 1½ x 2½	RA2-BE	5½	S9
56	¾ x 1½ x 2½			MC612, 614						
57	¾ x 1½ x 2½	S		MD418, MC612, 614, W612		39	¾ x 1½ x 2½	RA8-8BE	5½	S9
58	¾ x 1¾ x 2¼	S		MD414, 612, 616		40	¾ x 1¾ x 2¼	RA8-8BE	4½	S9
59	¾ x 1¾ x 2¾			56A		41	¾ x 1¾ x 2¾	RA2-8BE	8	S9
60	¾ x 2 x 2¼		K6, KG6	K6, KG6						
61	¾ x 2 x 2 5/16			SW75, EW, FW						
62	¾ x 2 x 2½			MC14, 16, 18, 70, 80, 90, 100, 141, 161, 181, 610	MC16, 18, 103, 161, 181	42	¾ x 2 x 2½	RA2-8BE	5½	S9
63	¾ x 2 x 2½	S		MD618, 423, 422, 422N		43	¾ x 2 x 2½	RA8-8BE	5½	S9
64	¾ x 2¼ x 2½			162		44	¾ x 2¼ x 2½	RA2-8BE	5½	S9
65	¾ x 2½ x 2 5/16			HW, IW		45	¾ x 2½ x 2½	RA2-8BE	5½	S9
66	¾ x 3 x 3			38B, 47, 47A, 47J		46	¾ x 3 x 3	RA2-8BE	5½	S9
67	⅞ x 1¼ x 2¼			MD106		47	⅞ x 1¼ x 2¼	RA2-8BE	5½	S9
68	⅞ x 1¾ x 2¼	S		W618		48	⅞ x 1¾ x 2¼	RA8-8BE	5½	S9
69	⅞ x 2 x 2½	S		MD420, 421, 420½		49	⅞ x 2 x 2½	RA8-8BE	5½	S9
70	⅞ x 2½ x 2 5/16			GW		50	⅞ x 2½ x 2½	RA2-8BE	5½	S9
71	1 x 1¼ x 2¼			MD107, 108, 109, 109½		51	1 x 1¼ x 2¼	RA2-8BE	5½	S9
72	1 x 1½ x 2½			MT1, 2, K9, KG9, K10, KG10		52	1 x 1½ x 2½	RA2-8BE	5½	S9
73	1 x 1¾ x 2½			MT3, 5		53	1 x 1¾ x 2¾	RA2-8BE	5½	S9
74	1 x 1¾ x 2¾			76A, 101K						
75	1 x 2 x 2¼			K7, KG7						
76	1 x 2 x 2½			MT4, 6MC103, 161		54	1 x 2 x 2½	RA2-8BE	5½	S9
77	1 x 2 x 2¾			50D						
78	1 x 2 x 2½	S		MT4, 6, MC103, 161		55	1 x 2 x 2½	RA8-8BE	5½	S9
79	1 x 2¼ x 2¼			K8, KG8		56	1 x 2¼ x 2½	RA2-8BE	5½	S9
80	1 x 2⅜ x 2¾			12A, 48, 48A, 48E		57	1 x 2⅜ x 2¾	RA2-8BE	7	S9
81	1⅛ x 1¼ x 2¼			MD110		58	1⅛ x 1¼ x 2¼	RA2-8BE	5½	S9
82	1¼ x 1 x 2½			165		59	1¼ x 1 x 2½	RA2-8BE	5½	S9

NEMA standard plate widths. This eliminated most of the variations, and resulted in 50 standards instead of possibly a thousand or so.

I believe that the manufacturers will agree that some such number will cover the requirements for all the mill type motors made by the various manufacturers.

Figure 1 is a suggested standard sheet for one standard, the split brushes on the 600 motor. At the top the sheet has a code number which is a standard number, and then the size of the brush, split. The shunt has the word "tinned" under it, and is followed by the brush data. At the bottom is shown the motors that use this standard. You will note that this standard takes care of the MD 418, Mc 612 and 614, and the W 612.

If this is adopted, when you order a brush for any of those four motors, all you need to do is say "Code No. 39," and the grade you select. Table I lists the suggested standards. The plate and clip widths have not been selected.

DISCUSSION

PRESENTED BY

HUGH CONOVER, Venice, Florida

Member: What did you do about beveling?

Hugh Conover: The mill type brushes are all radial with no bevels. So far, we have dealt only with mill type motors and bevel is not a question. We have used only two terminals, the S (slotted) terminals, 7/32 in. and 9/32 in. The shunt lengths, with one or two exceptions, are 3½ or 5½ in.

The shunts have been brought out on a bevel corner in position 2 or 8. They are riveted shunts.

Member: I should like to ask Mr. Conover whether they are using more than one grade of a particular manufacturer for a certain size brush; for example, if you are buying a carbon brush for a number of AISE No. 8 motors, would you use more than one grade from that manufacturer, or only one?

Hugh Conover: We have made no attempt to standardize grades. This is brush size and brush attachment standardization. I think the individual company or individual plant can standardize their own grades, simplify ordering and increase their discounts.

Specification for Design of Ladle Hooks, Association of Iron and Steel Engineers Standara No. 7

By W. H. MURSCH

Chairman, Sub-Committee on Design of

Crane Ladle Hooks

▲ DURING the year 1943, the Association of Iron and Steel Engineers began the investigation of the design of hot metal ladle hooks. The investigation was started by Professor H. A. Thomas of Carnegie Institute of Technology and completed in 1948 by Carl W. Muhlenbruch who was then associate professor of civil engineering at Carnegie Institute of Technology. Based on this research he made certain recommendations for the design and construction of this type of hook in his final report to the Association. (Analytical and Experimental Studies of Ladle Hooks, Carl W. Muhlenbruch, Iron and Steel Engineer, October, 1949, p 53-69.)

The investigations covered such items as type of rivets, riveting plus welding, edge welding, design formulae for calculating stresses, lateral bending stresses due to temperature gradient through the thickness of the hook due to radiant heat from the hot metal and causes of hook failure.

Based on these investigations, the committee has prepared a "Specification for Design of Ladle Hooks," known as Association of Iron and Steel Engineers' Standard No. 7. (Iron and Steel Engineer, October, 1949, p. 70-71.)

Considerable discussion took place on the merits of solid hooks flame cut from slabs, now that apparatus is available for detecting flaws hidden beneath the surface. Reference is therefore made in the specification to this type of hook.

I would like to discuss several items in this specification.

Materials—Nearly all plants and fabricators are in accordance with the class of materials specified.

Fabrication — There is considerable difference of opinion on the thickness of plates to be used, some preferring thick outer plates and some thin plates. We, therefore, leave it up to the plants to specify the thickness, if they have a preference.

The committee has recommended hot-driven rivets as being the most reliable method of holding the plates together. The rivet tests on cold driven rivets made by the pressure controlled riveter gave slippage greater than the hot-driven rivets. In addition, no plants manufacturing hooks are equipped with large enough riveters of this type. The method of using cold drive fit rivets in reamed holes and then heating the ends to upset into a countersink as specified by some plants seems to be satisfactory, provided care is taken that all rivets are a good drive fit their full length, thus completely filling the holes. This method, no doubt, is more costly than the hot driven rivets.

Stresses—The allowable combined stress of 12,000 psi may seem high to those who have been specifying a factor of safety of eight on the ultimate or four on the yield point. However, 12,000 psi gives a factor of safety of 2½ on the yield point, but if we deduct the stress due to the lateral bending, amounting to about 2500 psi, and which was never included in stress calculations before, we will have a factor of safety of about 3.16, still a little low. A check was made of a large number of hooks now in use and some of them had stresses as high as 16,000 psi; however, the large majority were in the neighborhood of 12,000 psi, the recommended maximum stress.

In some cases where the ladle trunnion pin is short and cannot be lengthened, it may be necessary to allow a higher stress.

Where the hook is hung on double pins, universal

joint fashion, so it can oscillate in either direction, the stress due to lateral bending will decrease in direct proportion to the distance from the bight to the section considered, becoming zero at the eye.

DISCUSSION

PRESENTED BY

FRANK W. CRAMER, Pittsburgh, Pa.
THOMAS F. READ, Alliance Machine Co., Alliance, Ohio.

F. W. Cramer: There is a tremendous amount of work back of that report on ladle hooks. One of the fortunate things about it is that the formula given in the report could be checked with actual installations, which the committee did, and they checked several hooks now in actual operation against the formula with the result that the formula was shown to be approximately correct.

In addition, the field check demonstrated the importance of the sidewise bending and temperature stresses, which are large, and which have been taken into account in the formulae.

The photoelastic work which was done at Lehigh and reported in the January 1948, Iron and Steel Engineer, "Photoelastic Analyses of Stresses in Crane Ladle Hooks," by F. K. Chang, K. E. Knudsen, and Bruce G. Johnston showed that the bending stress formula applies to all the various type hooks used in steel plant operations.

If the problem of possible flaws can be overcome (and equipment is available to detect such flaws), the solid hook would have several advantages. The rivet problem would be overcome, the temperature differential and resultant temperature stresses on both sides of the hook would be reduced, and lateral stresses would be minimized. This hook might, however, present some manufacturing problems for the larger cranes.

Thomas F. Read: My company concurs with these ladle hook design specifications. There was one question raised and that is, what should be the minimum thickness of the bushing used in the eye of the ladle hook? Our present standard is that this bushing thickness should not be less than ¾ in., and this will vary up to 1½ in. thick, based on the capacity of the ladle crane. As to a standard for determining this thickness, I know of none. We recommend that this thickness be set using ¾ in. minimum thickness.

AISE *Brake Standardization*

By V. E. SCHLOSSBERG
Chairman, Sub-Committee on Mill Motor Brake Standardization

The brake standardization work is being done by a joint AISE-NEMA committee. Most of the work under way at the present time is in the hands of the NEMA portion of the committee, which represents the brake manufacturers.

The development of a new line of brakes for the 600 series mill motor is a long and involved job. It is not merely a matter of getting a group of people together, and reaching a compromise on what the various dimensions should be. It involves, after an agreement on dimensions has been set by the committee, that each brake manufacturer actually design a brake on the basis of agreed-upon dimension to see whether they will actually work out. This is the phase of the project which is under way at the present time, and we cannot tell as yet whether the selected dimension will be agreeable to all the manufacturers. The following table gives the brake sizes and the wheel diameters which will probably be the final size selected. All of the design work so far has been on the basis of these wheel diameters, and so far nothing has developed to indicate that they are not satisfactory.

Motor frame "600" series mill motors	Series motors		Proposed ½-hr series brake and 1-hr shunt torque, lb-ft	1-Hr series brake torque, lb-ft	8-Hr shunt brake torque, lb-ft	Wheel diameter, in.
	Torque, 1-hr, lb-ft	Torque, ½-hr, lb-ft				
2	29	46	100	65	75	8
602	49	78	100	65	75	8
603	72	116	200	130	150	10
604	121	166	200	130	150	10
606	228	337	550	365	400	13
608	350	502	550	365	400	13
610	525	765	1000	650	750	16
612	850	1220	2000	1300	1500	19
614	1140	1780	2000	1300	1500	19
616	1750	2625	4000	2600	3000	23
618	2560	3615	4000	2600	3000	23

A great deal of work has also been done on other design features such as wheel widths, pressures and brake mounting dimensions, and agreement on some or all of these items is expected to be reached shortly.

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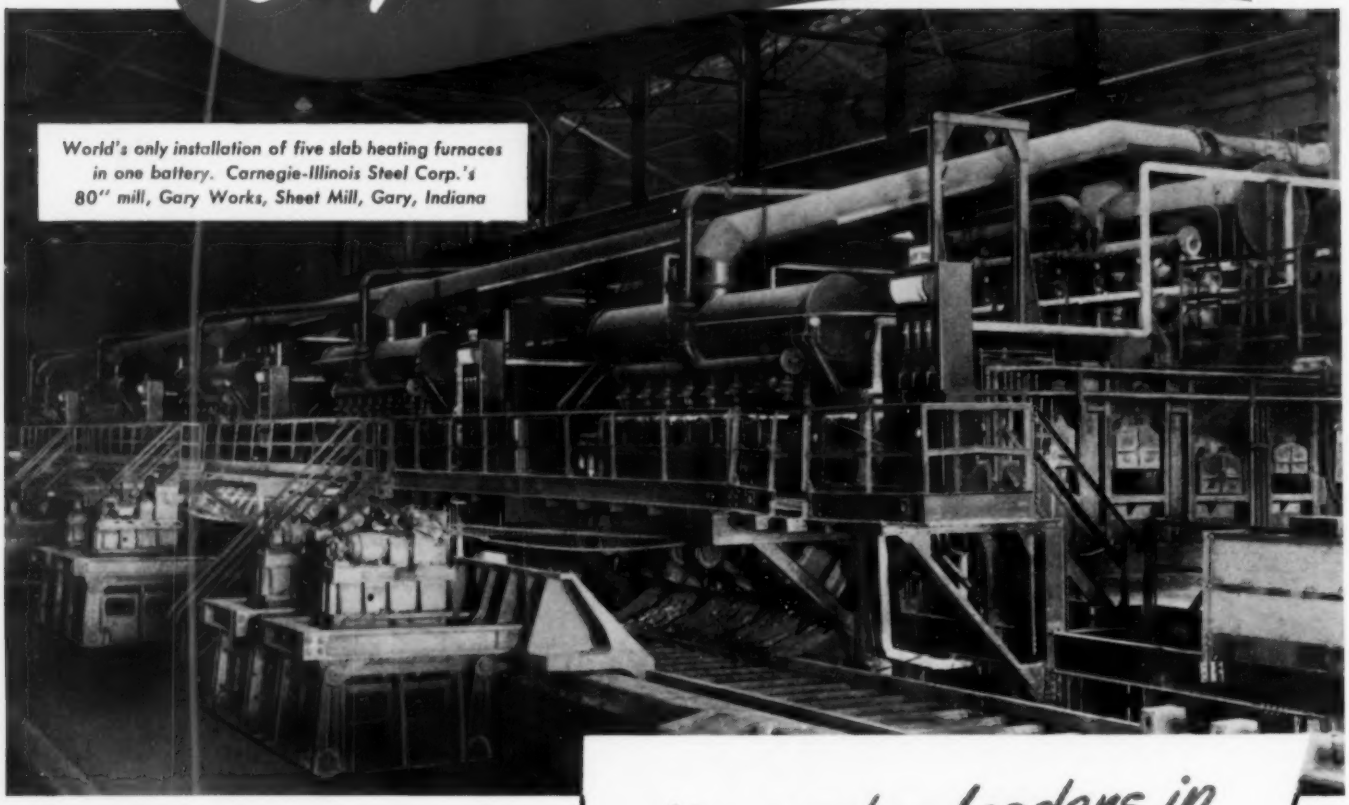

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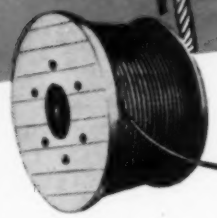

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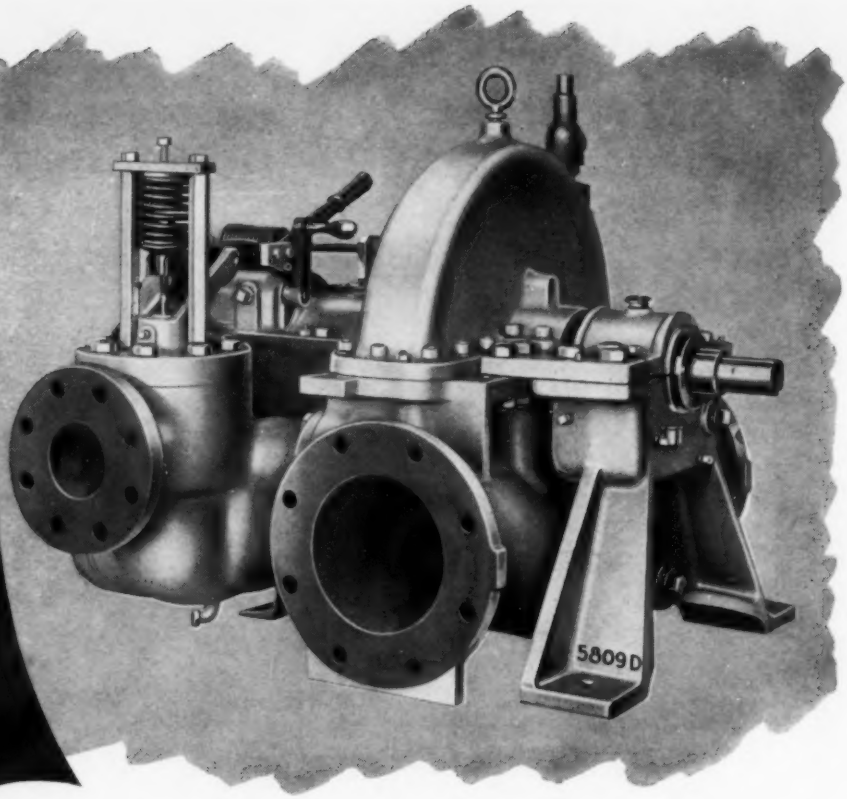

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Horizontal mechanical shaft governor control available for speeds up to 4500 rpm. Vertical geared mechanical and hydraulic governors for speeds up to 7000 rpm and precision controlled hydraulic relays. Remote control operation and pressure responsive controls also furnished.

Choice of hand valves

Hand valves are supplied for controlling steam admission to attain efficiency at partial loads or with varying steam pressures.

Whatever your operating conditions, De Laval gives the most efficient turbine for the job.

Before you buy, be sure and check these additional De Laval features:

- True center line support and flexible mounting for perfect alignment.
- Balanced double-seated bonnet-type governor valves for close control of steam flow.
- *Positive* over-speed protection entirely separate from normal speed governor for unfailing emergency shut-off.
- Sensitive, friction-free, wear-resistant "rocking chair" governor pivots.
- Super-smooth, chrome plated shaft journals make carbon rings last longer.
- Casing and bearings split horizontally at center line for easy removal and inspection of the rotor, carbon rings and bearings.

SEND FOR CATALOG 4202-25-R

DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

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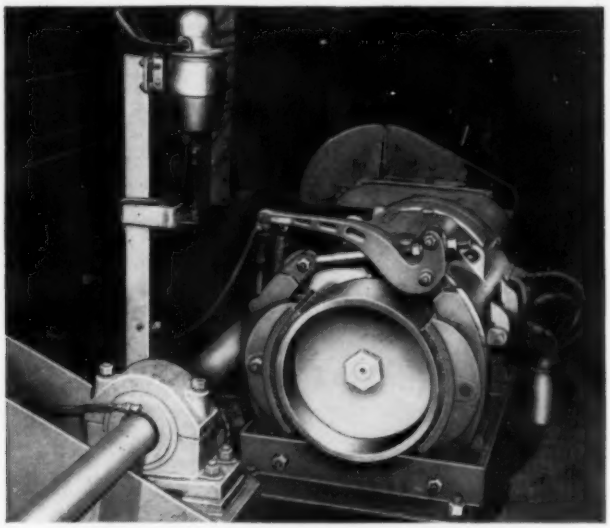
STOP YOUR CRANES

the way you stop your car with Wagner "FULL-CONTROL" HYDRAULIC BRAKES



Wagner Hydraulic Crane-Bridge Brakes have been service tested in industrial plants throughout the country. For safe, smooth stops—for controlled deceleration and close spotting—equip your cranes with Wagner "Full-Control" Hydraulic Brakes.

Only Wagner Hydraulic Crane-Bridge Brakes give you these features:

- **A Size and Type for Every Application . . .**
  Two types, with or without parking attachment, and four sizes are capable of handling any application.
- **Remote Control Bleeder . . .**
  Keeps lines full of fluid, maintains peak braking efficiency, and makes bleeding the system an easy, "one man" job.
- **Self-Centering Device . . .**
  Prevents brake shoe drag by assuring equal clearance of both brake shoes.
- **Other Advantages Include . . .**
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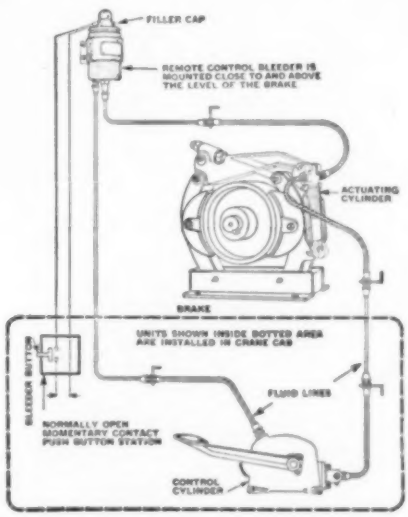
If your cranes are not equipped with Wagner brakes, one of our field engineers will gladly show you how simple it is to install a modern hydraulic system. If you now have Wagner brakes, your system can be quickly modernized with our complete conversion kits . . . Bulletin IU-40 gives full information—write for copy.

An overhead traveling crane and your own automobile have at least one point in common. They both need the best brakes available to keep their power and speed under safe control.

Hydraulic brakes have long since proved to be the answer in the automotive field. Hydraulic brakes have also proved superior to all other types for the bridge drives of overhead traveling cranes. Hydraulic brakes for bridge drives are included in the Specifications for Electric Overhead Traveling Cranes for Steel Mill Service, AISE Standard No. 6, Revised May 1, 1949.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REMOTE CONTROL BLEEDER IS MOUNTED CLOSE TO AND ABOVE THE LEVEL OF THE BRAKE
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UNITS SHOWN INSIDE DOTTED AREA ARE INSTALLED IN CRANE CAB
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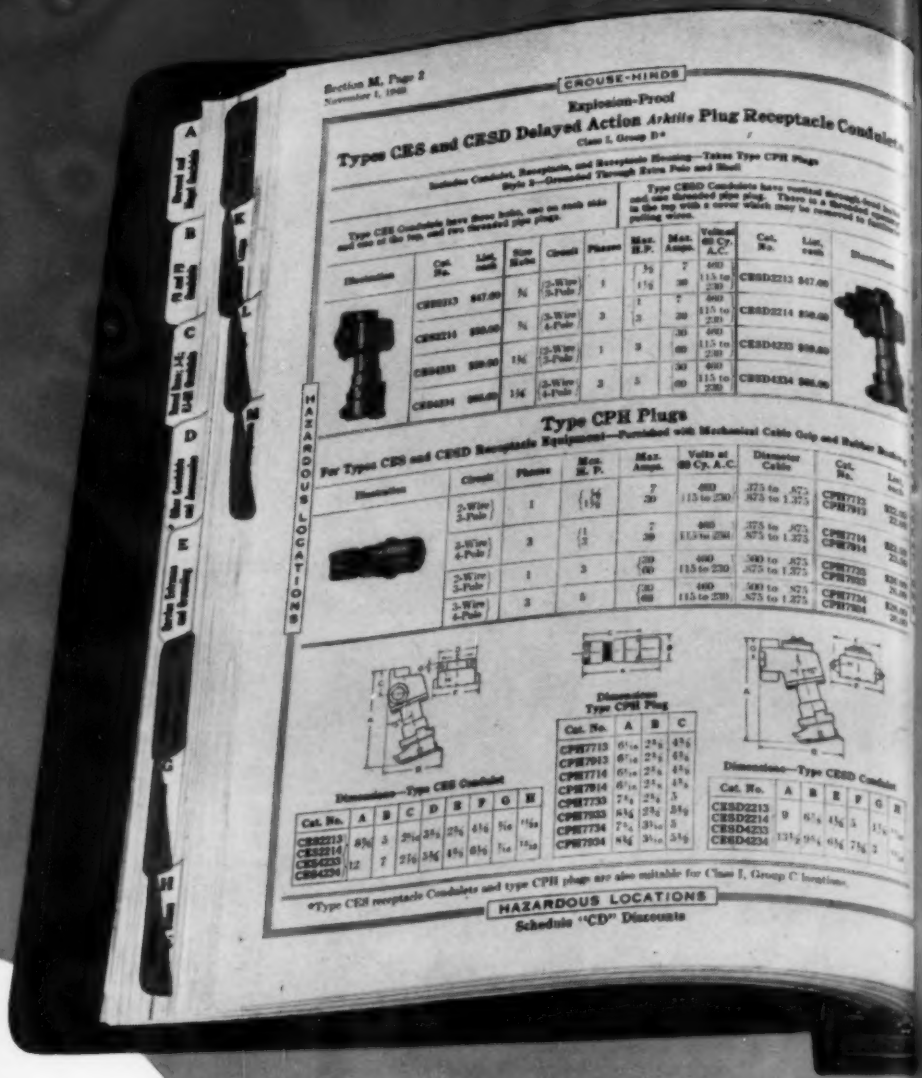

. . . with many

The many improved features in this catalog are the result of our years of cataloging experience combined with helpful suggestions from users of our products.

Among the outstanding features of the catalog are the logical divisions of Condulets into sections, the arrangement of the Condulets within the sections and the colored index tabs which simplify its use. For example, Section S contains listings of Condulets for industrial control. Section K contains listings of lighting fixtures

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NEW CONDULET Catalog

No. 3000

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20, 30, and 60-Ampere—250 Volts D. C., 600 Volts A. C.
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NEW features for your convenience

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Mica Insulation

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Provision for Expansion

Adequate Ventilation

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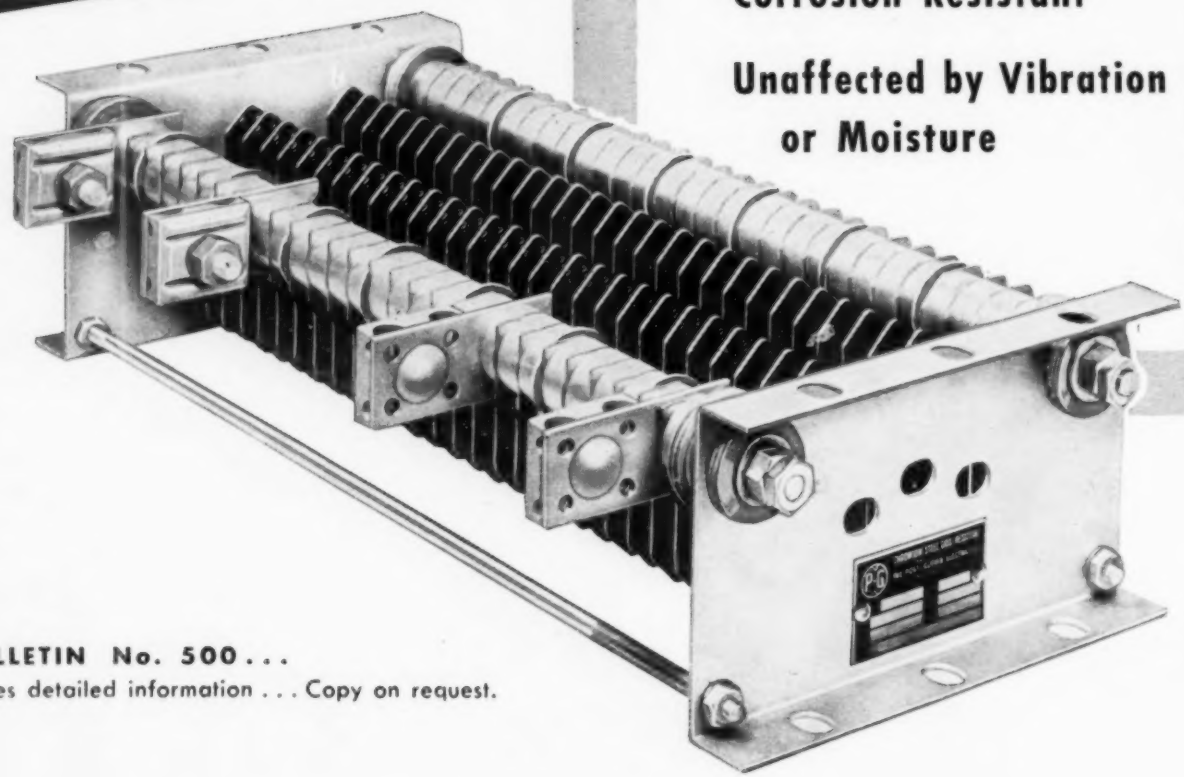

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Gives detailed information . . . Copy on request.

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THE Morgoil Bearings first purchased by 46 companies operating rolling mills totaled 920 bearings. Since that time these same 46 companies have purchased an additional 3780 Morgoils for other installations and are *now* operating a total of 4700 bearings . . . None have failed in service.

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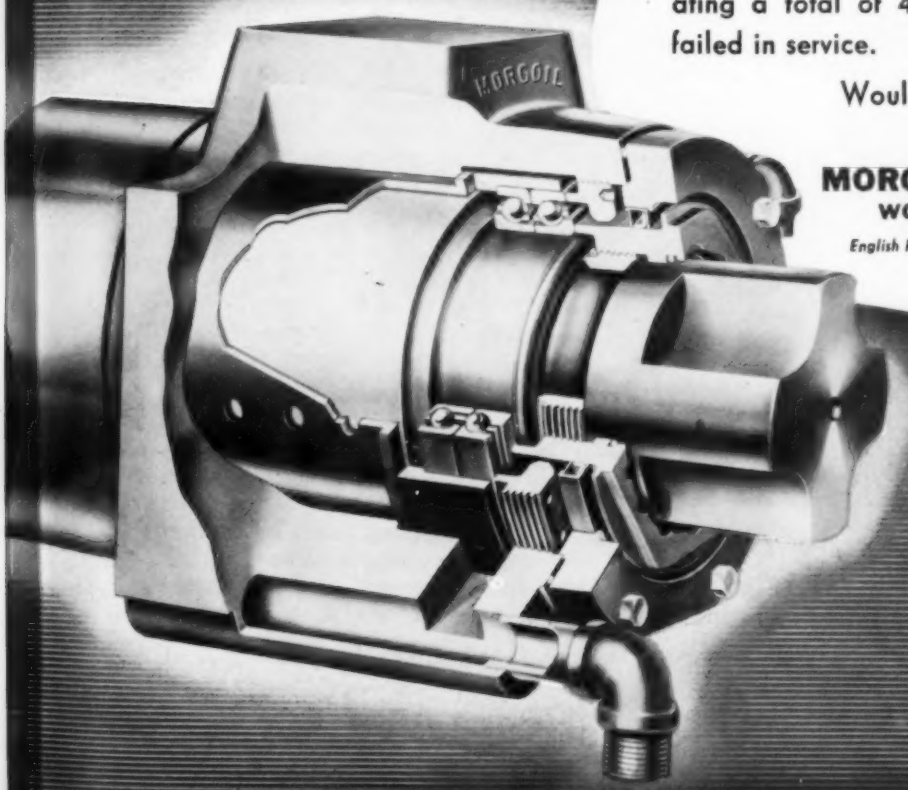

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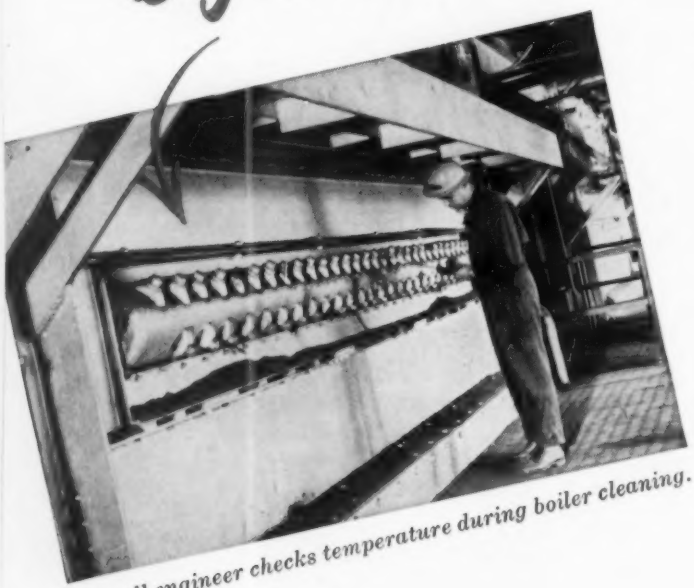
SERVICE SPECIALISTS IN MAINTENANCE CLEANING PROBLEMS

Big Boiler Cleaned in ONE DAY by Dowell Service!



Dowell engineer checks temperature during boiler cleaning.

A TYPICAL EXAMPLE of the economies afforded by Dowell Service is reported in the case of a midwestern refinery using five 300,000 lb. per hour boilers to generate electrical power. Before Dowell Service was used in the plant, boilers were usually down two weeks whenever repairs became necessary—during which time electricity was purchased from an outside source. Using Dowell Service to do the internal surface cleaning, the boiler is back in use in one week instead of the usual two! And the Dowell part of the operation takes just one day!

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For quick, practical, economical cleaning of boilers, heat exchange equipment, water lines and water wells, call the nearest Dowell office. Free cost estimates gladly given.

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DOWELL

A SERVICE ORGANIZATION

Date-line Diary...

January 1

▲ Total automobile and truck production in the United States was the highest in all history with a total output of 6,249,400 vehicles.

▲ E. R. Breech, executive vice president Ford Motor Co., stated that production in 1949 was the highest since 1929. Total units including coaches were 1,426,727 compared with 1,153,083 in 1948.

January 2

▲ Follansbee Steel Corp. sold its Toronto, Ohio plant and equipment to Kovalchick Industries, Inc. The plant includes four open hearth furnaces with an annual capacity of 136,080 tons of steel.

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate is scheduled at 96.1 per cent of capacity for the week beginning January 2, 1950. This is equivalent to 1,771,600 tons of steel compared with 1,716,300 tons one week ago.

January 3

▲ According to the Securities Exchange Commission, electric and gas utilities expect to spend record amounts in 1950 for expansion. They have scheduled $740,000,000 for the first quarter alone, out of $3,820,000,000 for all U. S. industry.

January 4

▲ Tin futures trading are being resumed on the New York Commodity Exchange after eight years of wartime and post-war suspension, and spot tin was being offered in New York at 77½¢ a lb, a decline of 27½¢ since September.

▲ Final papers were signed transferring the steelmaking properties of the Portsmouth Steel Corp. to the Detroit Steel Corp. Portsmouth received $6,200,000 and 285,000 shares of Detroit Steel common stock. A $10,000,000 expansion program is planned at Portsmouth.

January 5

▲ Treasury Department reported that the government debt at the end of 1949 was $257,000,000,000. In the first six months of the 1949-50 fiscal year expenditures totaled $20,974,000,000 and receipts were $17,675,000,000 for a deficit of about $3,000,000,000.

January 6

▲ According to a survey by the United Nations, Europe is building up its steel industries so that by 1953 total steel production, exclusive of the Soviet Union, will be about 70,000,000 tons. Estimated consumption in 1953 is 58,000,000 tons and with exports of about 4,000,000 tons there may be an unmarketable surplus of about 8,000,000 tons.

▲ President Truman in his message estimated that there would be 64,000,000 jobs by 1954 and a rise in national income at that time to $300,000,000,000. National income in 1949 totaled about $225,000,000,000, and 58,500,000 persons were working at the end of the year.

January 7

▲ Freight volume in 1949 on U. S. railroads was the smallest for ten years with 35,909,741 cars or 6,809,087 cars below 1948.

▲ National Coal Association reported estimated bituminous production for 1949 was 428,243,000 tons or 171,275,000 tons below the 1948 production of 599,518,000 tons in 1948.

January 8

▲ American Railway Car Institute reported that domestic freight car deliveries in December were 3330 compared with 9967 in December 1948. Deliveries for the year were 92,562 for the second highest total since 1924. The backlog of unfilled orders on January 1, was 12,036 compared with 103,896 one year ago.

January 9

▲ The Department of Commerce predicted that production of machinery and transportation equipment in 1950 should be about $28,300,000,000 or slightly under the $30,800,000,000 in 1949. It estimated also that factory auto sales in 1950 will be from 10 to 20 per cent below 1949.

▲ Based on reports of companies having 94 per cent the capacity of the steel industry, the operating rate is scheduled to be 97.2 per cent of capacity for the week beginning January 9, 1950. This is equivalent to 1,791,900 tons of steel ingots and castings compared with 1,771,600 tons one week ago.

▲ President Truman in his congressional budget message proposed federal spending of $42,439,000,000 in 1950-51. Without new taxes government receipts were estimated at $37,206,000,000 or an estimated deficit for the coming fiscal year of $5,133,000,000.

▲ Republic Steel Corp. estimated that its pension plan agreement with the CIO Steel Workers would cost $9,100,000 annually.

January 10

▲ Youngstown Sheet and Tube Co. cut back coke production about 30 per cent in the Youngstown District because of coal shortages.

▲ The Detroit Steel Corp. made arrangements for a loan totaling $15,000,000 through the use of 3¾ per cent mortgage bonds. $10,000,000 of this will be used for the expansion of finishing facilities at the Portsmouth plant.

January 11

▲ The F. W. Dodge Corp. reported that contracts for construction in the thirty-seven states east of the Rocky Mountains totaled $10,359,250,000 in 1949 or a gain of 10 per cent over 1948 and a new all-time record.

January 12

▲ The Inland Steel Co. and the Steep Rock Iron Mines, Ltd. announced an agreement in which Inland Steel took an option on a large undeveloped acreage, known as "C" ore body in the vicinity of Steep Rock Lake, Ontario.

▲ The Inland Steel Co. announced that it had accepted delivery of the "Wilfred Sykes," its new ore carrier and the largest ship ever built on the Great Lakes.

January 13

▲ British Steel Industry turned out 15,552,900 tons of steel in 1949 or 52,900 tons above the maximum goal set by the government. Coal production in 1949 was 202,695,000 tons.

▲ The Budd Co. has obtained an option in Gary, Ind. for land on which they plan to erect a stamping and assembly plant.

January 14

▲ Barium Steel Corp. announced that it had purchased the Chester Blast Furnace for $500,000. Furnace has a daily capacity of 600 tons.

January 16

▲ Based on reports from companies having 94 per cent of the capacity of the steel industry, the operating rate is scheduled at 98.2 per cent capacity for the week beginning January 16, 1950. This is equivalent to 1,810,300 tons of steel ingots and castings compared with 1,791,900 tons one week ago.

January 17

▲ Crucible Steel Co. cut steel production 25 per cent at its Midland, Pa. works because of coal shortages.

January 18

▲ American Iron and Steel Institute announced that annual capacity as of January 1st was 99,392,800 tons of ingots and castings. Steel companies increased capacity in 1949 by 3,271,870 tons. Blast furnace capacity was increased markedly during the year and as of January 1, 1950, it is rated at 71,497,540 tons. Coke oven capacity was increased about 500,000 tons during the year.

▲ Ford Motor Co. announced that it had purchased 200 acres in Cleveland, Ohio for the erection and production of a foundry and motor plant.

▲ Robert Denham, general counsel of the National Labor Relations Board, asked the Federal District Court for an injunction to stop John L. Lewis from using a three day work week and unfair tactics in seeking an illegal contract for his coal miners.

January 19

▲ It is reported that losses due to fire in 1949 dropped $667,000,000 from 1948's record total of $711,000,000.

▲ The No. 3 blast furnace at the Indiana Harbor works of the Inland Steel Co. was closed down tonight because of coal shortages.

▲ The Blaw-Knox Co. announced the formation of a new chemicals and fuels synthesis department which will develop processes and build plants for the conversion of fuels into chemicals and oils. Initially, they expect to use the Fischer-Tropsch process.

January 20

▲ The Barium Steel Corp. started to pour steel from two of the open hearths at Phoenixville, Pa. The blooming mill was also started.

January 23

▲ The American Iron and Steel Institute announced that $510,000,000 was spent in expanding and improving the steel industry plant and equipment in 1949. The companies plan to spend about $468,000,000 in 1950.

▲ Alan Wood Steel Co. started production today on the first hot strip mill in Eastern Pennsylvania, a 30-in., 6-stand hot strip mill.

▲ United States Steel Corp. estimated that its pension and insurance program this year will cost $78,000,000 or $67,500,000 more than the present program.

▲ Based on reports of companies having 93 per cent the capacity of the steel industry, the operating rate is scheduled at 93.9 per cent of capacity for the week beginning January 23, 1950. This is equivalent to 1,790,000 tons of steel ingots and castings compared with 1,810,300 tons one week ago.

January 24

▲ A report prepared for Chairman O'Mahoney stated that net income of fifty steel companies increased from $264,525,016 in 1946 to $542,085,610 in 1949.

January 25

▲ American Institute of Steel Construction estimated total bookings of fabricated structural steel in 1949 were 1,432,972 tons compared with 1,965,769 tons in 1948. Shipments for 1949 were 1,853,536 tons compared with 1,993,902 tons in 1948. Backlog as of January 1 was 555,360 tons.

▲ Plans are being made for new plant facilities by the Carnegie-Illinois Steel Corp. at Gary, Ind. to cost $100,000,000. Included is a $20,000,000 coal handling system.

▲ The Detroit Steel Corp. awarded the Pittsburgh Engineering and Machine Co. a contract for the construction of a 56-in., continuous hot strip mill to be built for Portsmouth, Ohio.

▲ The Inland Steel Co. declared a cash dividend of 50¢ a share on capital stock payable March 1, 1950.

▲ Republic Steel Corp. suspended operation at the No. 1 blast furnace in its Youngstown District because of the coal shortage.

▲ The Chrysler Corp. workers went out on strike to back up their pension demands.

January 27

▲ The Weirton Steel Co. awarded the Koppers Co. a contract for the construction of a battery of 61 Koppers-Becker underjet coke ovens. These will be capable of carbonizing 1500 tons of coal per day.

▲ The Youngstown Sheet and Tube Co. reported annual net income in 1949 of $31,777,010 compared with $35,711,732 in 1948. Net sales and other revenues in 1949 were $338,343,975.

▲ Bethlehem Steel Corp. reported reduced earnings for the fourth quarter of 1949 but record net profits for the whole year. Profits rose to $9.68 a common share in 1949 compared with $9.36 in 1948.

▲ The Cleveland-Cliffs Iron Co. raised iron ore prices 50¢ a ton.

January 29

▲ The Bethlehem Steel Co. will build a $30,000,000 addition at Sparrows Point, Md. to increase capacity 900,000 tons annually for tin plate, galvanized and hot and cold rolled sheets. Facilities should be completed in the second quarter of 1951. Ingots will come from Bethlehem and Steelton. The new work will include a 68-in., cold mill and an additional stand to the 58-in. mill.

January 30

▲ Based on reports of companies having 93 per cent the capacity of the steel industry, the operating rate is scheduled at 93.1 per cent of capacity for the week beginning January 30, 1950. This is equivalent to 1,774,700 tons of steel ingots and castings compared with 1,790,000 tons one week ago. Percentage estimate rate is based on new operating capacity figures.

January 31

▲ Jones and Laughlin Steel Corp. reported net income in 1949 of $20,961,245 compared with $31,222,451 in 1948. Total revenues in 1949 were $386,046,149.

▲ President Truman proposed a seventy day truce between the United Mine Workers and the soft coal operators while a special Fact Finding Board investigates the coal dispute. Under this proposal the miners would start normal production on Feburary 6.

▲ United States Steel Corp. reported total income for 1949 as $165,958,806, a return of 7.2 per cent on sales, equivalent to $5.39 a common share. This compares with an income of $129,627,845 in 1948. The common dividend declared was 65¢ per share, an increase over the 50¢ per share declared in the two preceding quarters.

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Out of Furnace Engineers' more than 30 years experience has come the ALL-IN-ONE BUY for galvanizing that sets new records for high production at low cost.

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It tells how F. E. I. technique has made ordinary methods obsolete.

Top photo: **F. E. I. equipment for galvanizing sheets.**

Lower photo: **F. E. I. installation for galvanizing metalware.**

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For longer magnet life and greater dependability, why not send your next order to Ohio—*25 years a leader in magnetic materials handling.*

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SELECT YOUR MAGNET from two Ohio types. The PROTECTO-WELD magnet, shown here, is made in 39, 46, 55 and 65-inch diameters. Bolted construction types include these and other smaller sizes.

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Ohio MAGNETS

A-1924

Industry News...

STEEL INDUSTRY CAPACITY APPROACHES ONE HUNDRED MILLION TONS A YEAR

▲ Steel capacity now closely approaches one hundred million tons a year, American Iron and Steel Institute announced recently upon completion of the Institute's latest annual capacity survey, as of January 1, 1950.

The new, record high capacity level is 99,392,800 tons of ingots and steel for castings, or about eleven million tons above the combined output of all the rest of the world last year.

An increase of 3,271,870 tons was achieved by steel companies during 1949 as the companies pushed their costly programs of expansion and improvement.

With that large increase, the companies of this industry have raised the total steel capacity nearly 18 million tons since 1940. Thus, steel capacity has risen nearly 22 per cent since 1940, while the population of the continental United States has increased about 15½ per cent.

The capacity increase during 1949 was substantially higher than expected under plans reported one year ago.

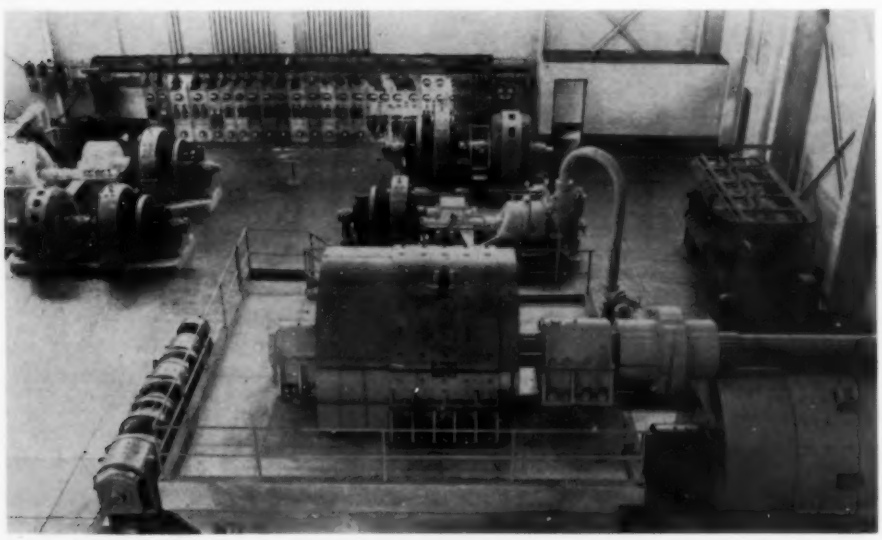
To support the great increase in steelmaking capacity, other producing facilities in the industry have likewise been expanded and improved. Blast furnace capacity was increased sharply during 1949 and as of January 1, 1950 is rated at 71,497,540 tons a year. Coke oven capacity has been increased about 500,000 tons. A number of new rolling mills have been added and other finishing facilities improved.

The total increase in steel capacity since 1940 is 17,773,300 tons. Last year's capacity was rated at 96,120,930 tons. The increase during 1949 was the second largest in any year since 1940.

With this announcement, the Institute revised the 1950 weekly rates, showing the percentage of capacity producing each week, as follows:

Week beginning	Percentage of capacity previously announced	Percentage based upon Jan. 1, 1950 capacity
January 2, 1950	96.1	92.9
January 9, 1950	97.2	94.0
January 16, 1950	98.2	95.0

REGULATOR REDUCES REVERSAL TIME



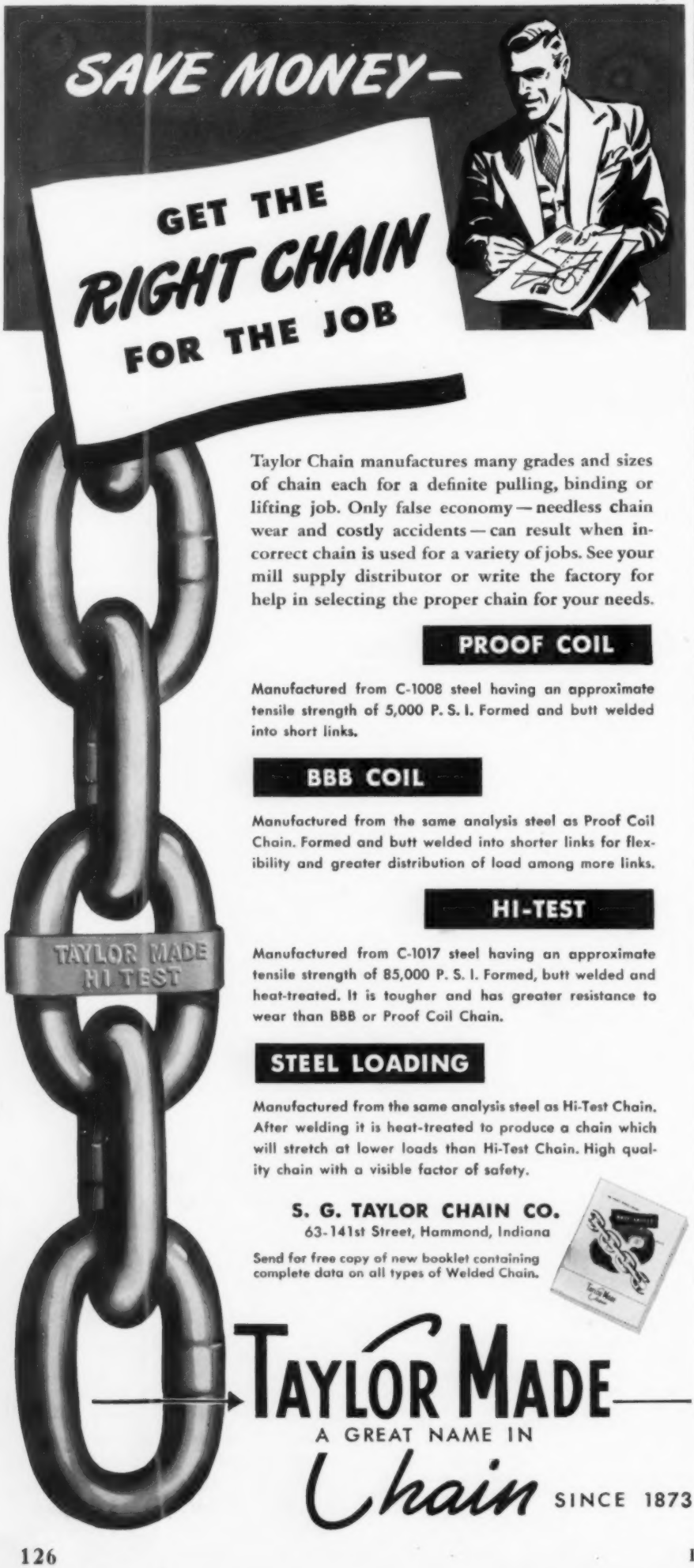
The use of rotating regulator control enables faster reversing time on blooming mills. The unit shown in the above photograph was put in service during the year at the Brackenridge plant of the Allegheny-Ludlum Steel Corp., and has a reversal time of 1.2 sec from base speed to base speed. The blooming mill is driven by two 3000 hp, 40/100 rpm, 600-v blooming mill motors. In the photograph is also shown a 5-unit, 1200-rpm, main motor exciter set consisting of a 100-kw, 450/225-v, d-c generator, a 40-kw, 400/200-v, d-c generator, a 30-kw, 75-v, d-c generator, a 25-kw, d-c generator, a 250-hp, 440-v, 3-phase, 60-cycle, 0.8-PF, synchronous motor. In the background can be seen two existing turbine generators and two existing motor generator sets for shop supply. Equipment was furnished by the General Electric Co.

ORGANIZE COMPANY TO MARKET TITANIUM

▲ National Lead Co. and Allegheny Ludlum Steel Corp. announced the formation of Titanium Metals Corp. of America, a new jointly owned organization which will market and distribute titanium metal, its alloys and various related products. The new company will make its headquarters in New York, N. Y.

National Lead Co. laboratories have been producing and studying titanium metal for many years and new facilities for output on a larger scale recently commenced production at the Sayresville, N. J., plant. Allegheny Ludlum, long the leading producer of stainless steel, has been conducting intensive research into the melting, alloying and processing of the new metal. It is now producing limited quantities of titanium metal forgings, bar, sheet, strip and wire for distribution to industry. Officers of Titanium Metals Corp. of America are as follows: president, H. C. Wildner; vice president, Clark W. King and secretary-treasurer, A. H. Drewes.

Under the proposed setup, the Titanium Metals Corp. will be a selling company. The National Lead Co. will process the titanium ore at its plants, and ship sponge titanium metal to the Allegheny Ludlum Steel Corp. The latter company will make the ingots with the required alloying additions, and fabricate the final product. The sponge is commercially pure, but since gases such as nitrogen and oxygen act as alloying additions to the titanium, the sponge metal must be melted in an argon atmosphere in water-cooled, cylindrical, copper, arc furnaces. The metallic



Taylor Chain manufactures many grades and sizes of chain each for a definite pulling, binding or lifting job. Only false economy — needless chain wear and costly accidents — can result when incorrect chain is used for a variety of jobs. See your mill supply distributor or write the factory for help in selecting the proper chain for your needs.

PROOF COIL

Manufactured from C-1008 steel having an approximate tensile strength of 5,000 P. S. I. Formed and butt welded into short links.

BBB COIL

Manufactured from the same analysis steel as Proof Coil Chain. Formed and butt welded into shorter links for flexibility and greater distribution of load among more links.

HI-TEST

Manufactured from C-1017 steel having an approximate tensile strength of 85,000 P. S. I. Formed, butt welded and heat-treated. It is tougher and has greater resistance to wear than BBB or Proof Coil Chain.

STEEL LOADING

Manufactured from the same analysis steel as Hi-Test Chain. After welding it is heat-treated to produce a chain which will stretch at lower loads than Hi-Test Chain. High quality chain with a visible factor of safety.

S. G. TAYLOR CHAIN CO.
63-141st Street, Hammond, Indiana

Send for free copy of new booklet containing complete data on all types of Welded Chain.

TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

additions for the titanium alloys are made at this time. Incidentally, this type of titanium alloy should not be confused with the older titanium alloys in which titanium is used as an addition agent to a ferrous metal. These titanium alloys are similar to aluminum alloys in that they consist predominately of titanium and have a relatively small percentage of alloying elements. There are no serious problems apparently in either hot rolling or cold rolling the titanium metal, and stainless rolling and fabricating facilities can be used. Hot rolling temperatures are much lower and run from 1450-1500 F.

Titanium offers many possibilities as the metal is non-corrosive (even in salt water) and in some acids. The physical properties are also desirable because of the high strength-weight ratios. Some of the titanium alloys have tensile strengths up to 150,000 psi, yield points up to 125,000 psi, with elongations of 18-20 per cent and reduction of area of about 28 per cent.

DETRICK ACQUIRED FURNACE ARCH FIRM

▲ The industrial department of the American Arch Co., Inc., New York, has been purchased by the M. H. Detrick Co. and is being operated as the M. H. Detrick Co. American Arch division with offices in the Oliver Building, Pittsburgh, Pa.

Former American Arch Co. industrial department executive personnel have been retained to operate this division.

LACKAWANNA PLANT ADDS ELECTRICAL EQUIPMENT

▲ The Westinghouse Electric Corp. reports that it has received an order for approximately $650,000 of additional electrical equipment for the 79 in. hot strip mill at the Bethlehem Steel Co., Lackawanna, N. Y.

The order includes adjustable voltage screwdowns for the blooming mill; two 4500-hp motors; a 4000-kw, 600-volt ignitron rectifier, which will be operated in parallel with 14,000 kilowatts of existing generating equipment; plus ventilating equipment, switchgear, a 1500-kva power center, and other small horsepower mill auxiliary equipment.

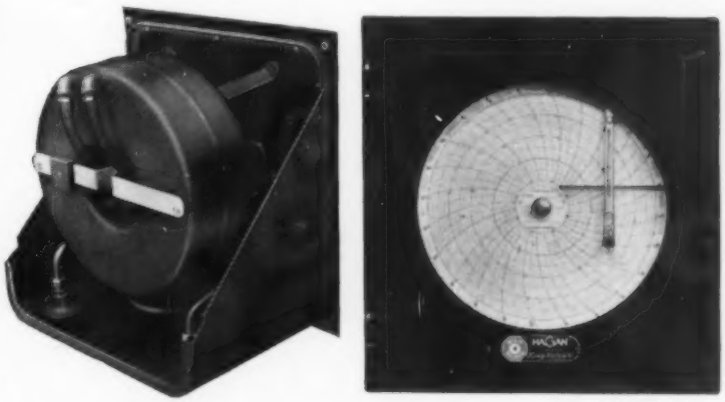
Sensitive...accurate...reliable

Hagan Ring Balance Draft Gage

The basic principle of the Hagan Draft Gage is the same as that of the Hagan Ring Balance Flow Meter. It is a radial torque device which uses a hollow ring body to convert difference in static pressure into a rotation which is transmitted to recorder or indicator. The ring body is partially filled with a sealing fluid, and is divided into two compartments by means of a baffle in the upper part of the ring.

As in the Flow Meter, there is an opening in the ring on each side of the baffle. One of these openings is connected to the pressure to be measured; the other is open to the atmosphere. The difference between this pressure and the pressure of the atmosphere — whether positive or negative — causes rotation of the ring body. The ring moves through an arc of 15°, with a radius of 5 to 5½ inches, thus giving far greater total movement than any other type of draft gage.

The ring assembly is mounted on a knife-edge bearing. This mounting, plus the fact that there are no stuffing boxes, virtually eliminates friction. There is no diaphragm to dry out, no bellows to crack or corrode. Unexpected pressure rises do not damage the gage or affect its accuracy. At the most, a sudden high pressure will do no more than drive the sealing fluid from the ring body, and as soon as the fluid is replaced the gage is again ready for use.



For full information on Hagan Ring Balance Draft Gage, fill in the coupon below or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

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RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
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HAGAN CORPORATION
Hagan Building
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Please send information concerning Hagan Ring Balance Draft Gage.

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Company_____

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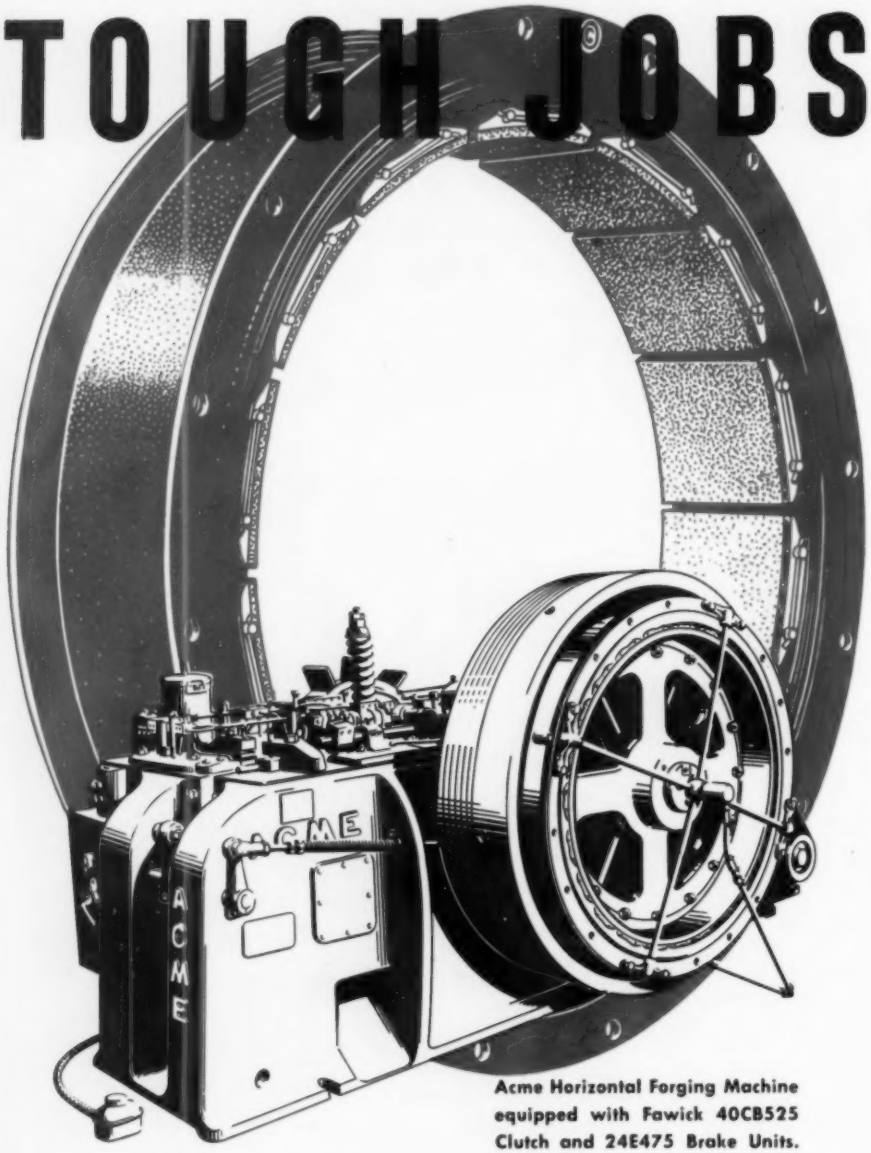
FAWICK CLUTCH AND BRAKE UNITS ARE BUILT FOR TOUGH JOBS



Acme Horizontal Forging Machine equipped with Fawick 40CB525 Clutch and 24E475 Brake Units.

In heavy industry it pays to be tough. The rugged design and materials used in Fawick Clutch and Brake Units pay users big dividends. Operating cycles of Fawick-equipped machines are speeded up, "down-time" due to premature wear or breakage is reduced, and lost time for maintenance and adjustment is minimized.

Tough jobs demand tough, long-lasting clutches—That's why Fawick Clutch and Brake Units are built tough!

For specific information on all advantages of Fawick Industrial Clutch and Brake Units, write to the Main Office, Cleveland, Ohio, for Bulletin 300.

All desirable clutch characteristics are built into Fawick Airflex units

FAWICK Airflex CO., INC.
9919 CLINTON ROAD CLEVELAND 11, OHIO

WEIRTON CONTRACTS FOR COKE OVEN BATTERY

▲ Weirton Steel Co. has awarded Koppers Co., Inc., a contract for the construction of a battery of coke ovens, and alterations and extensions on the by-product and benzol plants at its Weirton, W. Va., plant. Work on the project will be completed by the end of 1950.

The new battery of 61 Koppers-Becker underjet coke ovens, arranged for blast furnace gas underfiring and equipped with self-sealing doors, will be capable of carbonizing approximately 1500 tons of coal per day.

Work on the by-product and benzol plants will include the installation of additional booster, exhauster, and primary cooler units as well as new light oil recovery and refining facilities.

KOPPERS TO SUPERVISE HUGE TURKISH EXPANSION

▲ Engineering and construction work under the ECA program in Turkey, to cost approximately $50,000,000, will be supervised by Koppers Co., Inc., Pittsburgh, Pa., during the next four years. Koppers Co. has signed a contract with E.K.I., Turkish mining concern which is controlled by the government banking organization, E.T.I. The contract covers supervision of construction of a harbor, improving of mining properties including construction of coal washeries, and construction of certain railroad facilities. Koppers also will inspect the equipment for the projects which will be procured in the United States and in Europe.

Most of the work will be done in the vicinity of Zonguldak, Black Sea port located about 200 miles northwest of Ankara. The contract between Koppers and the Turkish concern was signed in Ankara.

Under the contract, Koppers will name a director of operations to head up the group of projects. He will be assisted by a staff of seven, including a mining engineer, a harbor engineer, four civil engineers, and a chief accountant. It is estimated that approximately four years will be required to complete the projects.

Two new docks and a large breakwater are to be built at the port of

why CRANE
DIAPHRAGM VALVE DESIGN
is Superior

WORKING PRESSURES:
150 Pounds
water, oil, air, or gas;
½ through 4-in. sizes
125 Pounds
water, oil, air, or gas;
6-in. size only
180 Deg. F.
max. temp.; all sizes

LONGER DIAPHRAGM SERVICE LIFE—Diaphragm is not subject to cutting, crushing, and rapid wear since it is used *only* to seal the bonnet; not for seating purposes.

POSITIVE SHUT-OFF in case of diaphragm failure. *This is an exclusive Crane safety feature.*

ACCURATE SEATING—Circular flat face disc with resilient neoprene seating surface gives tight closure—independently of diaphragm—on all fluids.

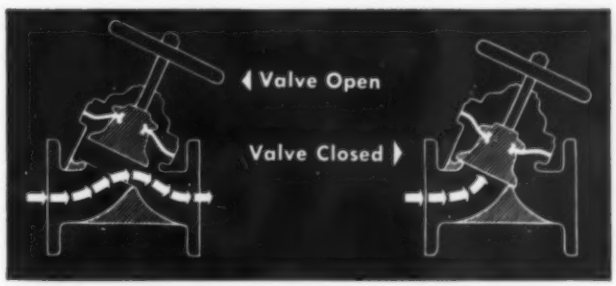
GREATER FLOW CAPACITY—Y-pattern body design gives closer approximation to straight-line flow, reduces resistance and pressure drop.

EASIER OPERATION—Less torque— fewer turns—needed to operate valves—especially in larger sizes.

PLAIN IRON OR NEOPRENE-LINED—Unlined valves will handle all common services. Neoprene-lined valves are recommended for fluids corrosive to iron but non-active chemically upon neoprene.

HOW IT WORKS

The Crane diaphragm performs one job only—sealing the bonnet against line fluids. The seating member is a separate circular flat face disc, firmly attached to the stem and joined to the diaphragm with a special leakproof connection. This independent seating arrangement permits positive shut-off of flow, even in case of diaphragm failure.



SEND FOR THIS NEW CIRCULAR

Contains complete information about these outstanding valves—including all essential specification data, service recommendations, and list prices. Ask your Crane Representative for your copy, or WRITE FOR CIRCULAR AD-1761. No obligation.

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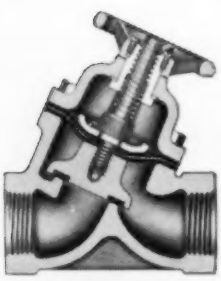
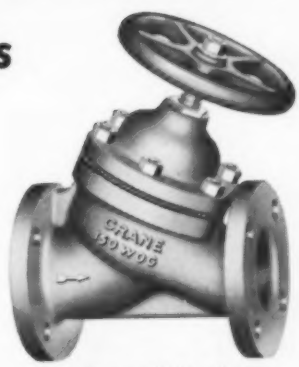
NOW AVAILABLE IN SIZES UP TO 6-INCHES



No. 1610
Screwed ends
½ to 2-in.

No. 1611
Flanged ends
½ to 6-in.

No. 1615
Neoprene-lined, Flanged ends
½ to 6-in.



2½, 3, 4, and 6-in. valves, Plain iron or Neoprene-lined, have rising, turning stem

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VALVES
FITTINGS
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CRANE

PLUMBING
AND
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FOR EVERY PIPING SYSTEM

MEDART MULTICYCLE

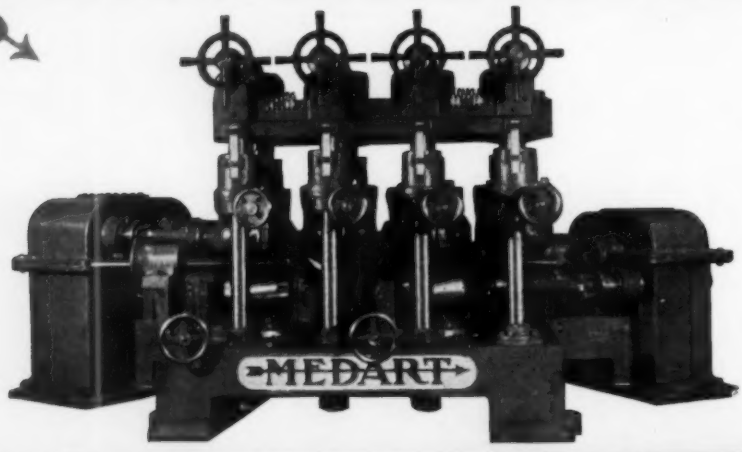
PIPE AND TUBE STRAIGHTENING MACHINE

"6 in 1"

SIX POINTS OF SUPERIORITY IN ONE

1. MULTICYCLE STRAIGHTENING—Two bending rolls impose duplex straightening cycles on workpiece insuring end to end straightness.
2. POSITIVE AND SYNCHRONIZED FEED—All four feed rolls are driven insuring positive synchronized feed and torque balanced around neutral axis of workpiece.
3. THE WORKPIECE LEVEL—Maintains one feeding level for all sizes of pipes or tubes—eliminates need of adjustable entry and delivery tables.
4. NO GUIDES—Horizontal position of the six rolls with balanced torque eliminates requirement for guides.
5. SINGLE MOTOR—All four driven rolls powered from a single motor, for synchronization and economy.
6. NO BEVEL GEARS—All gears enclosed in cases and running in oil, for sure trouble free operation.

"Patents make Jobs"



MANUFACTURING ENGINEERS OF COMPLETE TRANSMISSION EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY • 3500 DE KALB ST., ST. LOUIS, MO.

Zonguldak. In the same vicinity, Koppers will supervise the improvement of mining facilities, including the building of new tipples and two coal preparation plants. Also in the overall project coming under Koppers' supervision will be construction of approximately eight miles of railroad and a complete switching and transfer station.

Some of the equipment for the projects will be purchased in this country and some will come from European nations and from Turkey itself.

Turkey is the third foreign country in which Koppers now has contracts. The engineering and construction division is pushing toward completion an integrated steel plant near Concepcion, Chile. A coke oven construction contract in Nova Scotia also has been virtually completed by Koppers.

MILLIONTH TON POURED AT KAISER STEEL

▲ The millionth ton of steel ingots for the calendar year 1949 was poured on December 29, at the Fontana, Calif., plant of the Kaiser Steel Corp., marking the first time that any Pacific coast steel company has produced a million tons of steel ingots in a single year.

Attainment of this record was made possible in part by the addition of a second blast furnace, which was "blown in" in October, doubling the mill's potential pig iron capacity. The increased production of hot pig iron, together with the addition of a seventh open hearth furnace a year

This is the first time that a West Coast mill has produced a million tons of steel ingots in a single year.

MEET the family of Johns-Manville Insulating Fire Brick . .

HERE IS AN OUTSTANDING FAMILY of insulating fire brick for back-up or exposed use . . . the only family of its kind . . . that gives you a complete range . . . a *quick heating* insulating fire brick for every purpose.

By taking advantage of the quick heating characteristics of these insulating fire brick, you'll benefit through important savings in fuel because of the quicker rise to proper operating temperature in the furnace. This is a result of the low heat storage capacity and low thermal conductivity characteristics of the brick. These factors are especially important where furnaces are being intermittently operated.

The same materials can also be obtained in large size units as Johns-Manville Insulating Fireblok. This product has many advantages over the smaller size fire brick, from both a construction and stability standpoint. They can be quickly applied because they are easy to cut and fit. J-M Insulating Fireblok provide additional heat savings because they reduce the number of joints, and require less mortar for bonding.

Why not have a Johns-Manville insulation expert call to tell you more about ways in which you can save by using these insulations in your furnaces. Write Johns-Manville, Box 290, New York 16, N. Y. for further information.

	JM-1620	JM-20	JM-23	JM-26	JM-28	JM-3000
Densities, lb per cu ft	29	35	42	48	58	63-67
Transverse Strengths, psi	60	80	120	125	120	200
Cold Crushing Strengths, psi	70	115	170	190	150	400
Linear Shrinkage,† percent	0.0 at 2000 F	0.0 at 2000 F	0.3 at 2300 F	1.0 at 2600 F	4.0 at 2800 F	0.8 at 3000 F
Reversible Thermal Expansion, percent	0.5—0.6 at 2000 F	0.5—0.6 at 2000 F	0.5—0.6 at 2000 F	0.5—0.6 at 2000 F	0.5—0.6 at 2000 F	0.5—0.6 at 2000 F
Conductivity* at Mean Temperatures						
500 F	0.77	0.97	1.51	1.92	2.00	3.10
1000 F	1.02	1.22	1.91	2.22	2.50	3.20
1500 F	1.27	1.47	2.31	2.52	3.00	3.35
2000 F	—	1.72	2.70	2.82	3.50	3.60
Recommended Service						
Back up	2000 F	2000 F	2300 F	2600 F	2800 F	3000 F
Exposed	1600 F	2000 F	2300 F	2600 F	2800 F	3000 F

† *24-hr simulative service panel test for JM-3000; 24-hr soaking period for other brick.*

* *Conductivity is expressed in Btu in. per sq ft per F per hour at the designated mean temperatures.*

Note: Above tests are in accordance with A.S.T.M. tentative standards.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville First in INSULATIONS

ago, gives Fontana a potential of 1,130,000 tons of steel ingots per year.

The record ingot production at Fontana comes at a time when the company is broadening its range of finished steel products. Early in 1950 Kaiser Steel expects to begin operation of a new hot rolled strip mill for the production of hot rolled strip and sheet up to 72 in. wide, and a new electric weld pipe mill to produce pipe from 5½ in. to 12¾ in. in diameter.

J & L GEOLOGIST FINDS RADIOACTIVE MATERIAL

▲ Jones & Laughlin Steel Corp. has announced that a discovery of radioactive material has been made in the Upper Peninsula of Michigan. The discovery was made in August, 1949, by a geologist who was employed during the summer months by Jones and Laughlin Ore Co., a subsidiary of Jones & Laughlin Steel Corp.

The radioactive material has been identified by scientists of the United States Atomic Energy Commission as uranium oxide in the form of pitchblende. The discovery was made as a result of a systematic search for uranium in an area which seemed to have geologic promise for such discovery.

The exposures for study in the outcrop are not sufficient to determine whether this prospect carries a mineable quantity of uranium ore.

An application has been made for a lease on certain state lands involved and arrangements have been made with the Ford Motor Co., owners of the other lands in the vicinity so that exploration may be carried on to determine whether this occurrence is of any economic importance.

TRABON LICENSES ENGLISH FIRM

▲ Trabon Engineering Corp. has licensed a firm in England to produce the same type of equipment which now serves thousands of plants throughout the United States, Canada, and countries abroad.

The British company is Exactor Control Co., Ltd., with offices at 108 Park St. in London, which has organized a division to be known as Exactor-Trabon. A new factory, located near that city, is being equipped for complete manufacturing. Exactor-Trabon will engineer, install, and service the complete line of Trabon lubricating equipment.

Territory served by the new company includes Great Britain and continental Europe.

DRAVO APPOINTS CHICAGO REPRESENTATIVE

▲ Geo. B. Limbert & Co., Inc., 208 South Lasalle St., Chicago, Ill., has just been appointed representative for Dravo Corp., Pittsburgh, Pa., in the sale and installation of fabricated piping for industrial plants, oil fields, central utility stations, water works, gas transmission systems and other services.

RUST HAS SUBSTANTIAL INCREASE IN 1949

▲ The volume of steel mill modernization, new furnaces, and other

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for HIGH SPEED
STEEL MILL
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Demands for more steel production and the resulting speed-up of mills require increased circulation of lubricating oils and coolants.

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We'll gladly have one of our engineers call at your convenience. No obligation — just wire, phone or write us.

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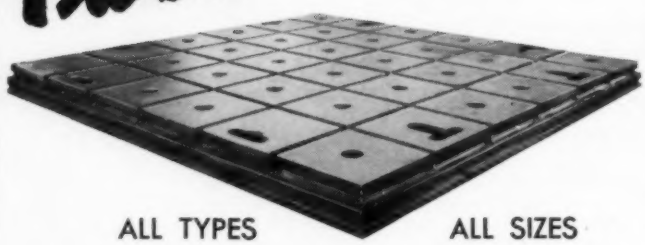

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ALLOY IRON ROLLS
ROLLING MILL MACHINERY
GRAY IRON CASTINGS
(Up to 80,000 pounds)

Inquiries invited.

HYDE PARK FOUNDRY & MACHINE CO.
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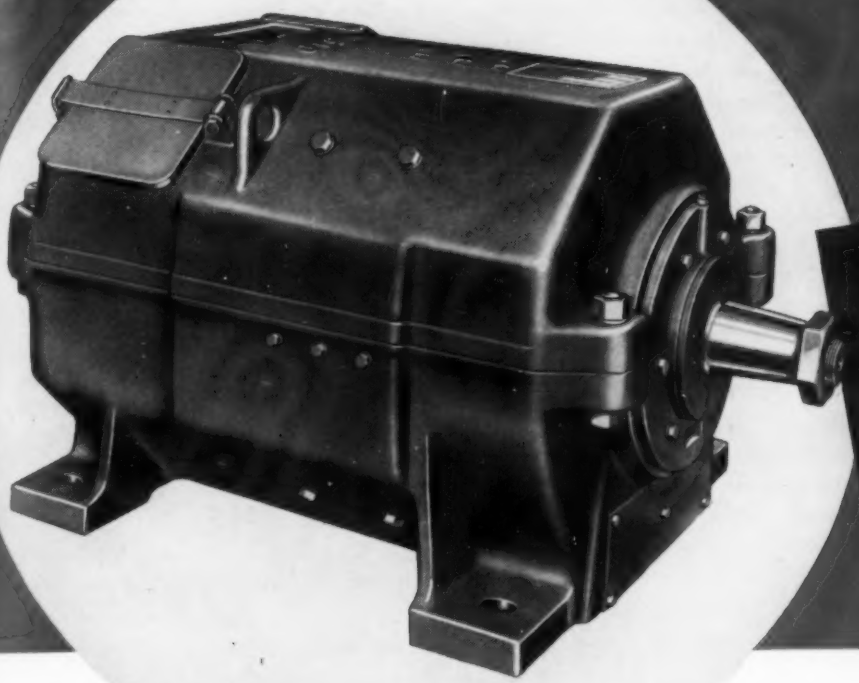
NOW READY!

The New CROCKER-WHEELER

FORM W 600 SERIES

AUXILIARY MILL MOTOR

For Heavy Duty Mill and Crane Service



BUILT TO THE STEEL INDUSTRY'S SPECIFICATIONS!

Here's the mill motor the steel industry wanted. This new improved Form W 600 Series by Crocker-Wheeler is built to A.I.S.E. Standard No. 1. And it's available now!

More active material is provided in the same amount of space. Better utilization of existing space increases horsepower without adding to frame size.

Steel men said they wanted accessibility for motor servicing. Note, in the illustration above, how easy it is to get at all motor parts. And this is merely one of many new features Crocker-Wheeler has built into its new Form W 600 Series motors.

Crocker-Wheeler engineers are accredited specialists in building motors for cranes and heavy auxiliaries in steel mills. C-W designed the first mill type motor as far back as 1905, and has been making motor news in the steel industry ever since.

Find out more about the new Crocker-Wheeler Auxiliary Mill Motors—their greater efficiency, ease of maintenance and other unique advantages.

Send today for Bulletin SL 620-1 describing this new mill motor. Write Advertising Department, Elliott Company, Jeannette, Pa.

✓ CHECK THESE LOW MAINTENANCE — LONG-LIFE FEATURES

FIELD COILS Wound on mold over mica cell. Mica-washers at top and bottom of coil. Glass tape applied over cell, washers, and coil. Coil is filled layer by layer, during winding, with insulating compound that resists high temperatures, moisture, and oil, and provides an extremely homogeneous structure.

ARMATURE COILS Conductors are silicone-bonded, double-glass-covered wire. Slot portion of coil insulated with 4½ layers of glass-backed mica wrapper lapping with layers of glass-backed mica tape which extend around the coil bends and nose for reinforcement. Entire coil taped with closely woven glass tape.

INTERNAL CIRCULATION Integrally-cast fan blades on rear coil support circulate air through core ducts and between field coils, dissipating heat to frame. Provision is also made for forced ventilation.

GET COMPLETE DETAILS of these and many other reasons why the new Crocker-Wheeler Form W 600 series is your best buy in mill motors. Ask for Bulletin SL-620-1.

ELLIOTT COMPANY

CROCKER-WHEELER DIVISION

AMPERE, NEW JERSEY

Branch Offices: Birmingham, Boston, Buffalo, Chicago, Cleveland, Cincinnati, Dallas, Denver, Houston, Los Angeles, Milwaukee, Newark, New Orleans, New York, Philadelphia, Pittsburgh Salt Lake City, San Francisco, Seattle, Washington, D. C.

IF CROCKER-WHEELER BUILDS IT IT'S A BETTER-BUILT MACHINE

metal trades construction handled by Rust Engineering Co., and subsidiaries, Pittsburgh, Pa., and Birmingham, Ala., in 1949 increased substantially over the previous year according to the company's year-end report.

Besides the increased volume, which included projects in South Africa, Europe and South America, a number of major steel industry contracts were completed in record time to achieve the least possible interference with production schedules, company officials said.

A notable record was construction of the new 1,000,000-lb-per-hr steam plant for Jones & Laughlin Steel Corp., Pittsburgh, Pa., works in 400 days. Rust Furnace Co., a subsidiary, completed another Jones & Laughlin contract in a record 14½ weeks when it consecutively built three slab heating furnaces for the 96 in. continuous hot strip mill.

Installation of a new 66 in. 4-high reversing Steckel hot strip mill, first major installation of its kind, was completed at the Midland, Pa., works of Crucible Steel Co. of America.

Modification and re-erection of the reversing roughing mill and construction of cross-transfer tables serving it were completed, as an integral part of the new project, in a record 59 days which permitted production schedules to be maintained with the least possible interference.

Two modern 75,000-lb-per-hr steam generating units were also installed at Crucible Steel's Midland, Pa., works to supplement ten 10,000-lb-per-hr Rust boilers which have been in continuous use for 45 years.

Jones & Laughlin's entire new steam plant, which was designed and constructed by Rust Engineering, replaced 43 old boilers with five new units, increasing efficiency with less space and lower operating costs, while helping further Pittsburgh's smoke control program.

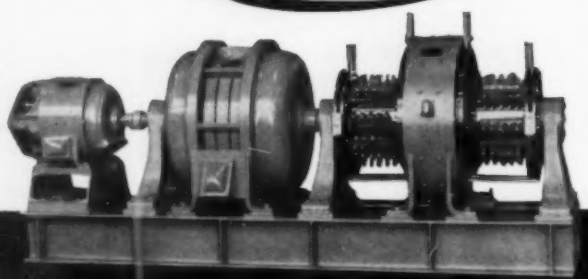
A new open hearth furnace was completed by Rust Furnace Co. for the Granite City Steel Co., Granite City, Ill., a $1,500,000 project including a new chimney and facilities construction carried out by the parent firm to serve the new furnace as part of an over-all modernization program.

These three steel slab heating furnaces at the Pittsburgh, Pa., works of Jones & Laughlin Steel Corp. were consecutively built in a record 14½ weeks by the Rust Furnace Co. The new furnaces serve the 96 in. continuous hot strip mill with greatly increased capacity.

New billet heating furnaces were completed for Colorado Fuel and Iron Corp., at Pueblo, Colo., and the Timken Roller Bearing Co., Canton, Ohio; while an annealing furnace was designed and placed in operation for Alabama Pipe Co. at Anniston, Ala.

As designer-constructor, the furnace company also completed a continuous bloom heating furnace for the National Supply Co. at Ambridge, Pa., and a furnace for heat treatment of complex pipe assemblies

Motor Generators
by COLUMBIA



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Electrocleaning — Electropolishing

There's a Columbia M-G Set available for your needs, whether you have a small plating bath or a large continuous strip plating line. Capacities up to 20,000 Amperes; 6 Volts and up. Dependable, performance proved, for many years. Your inquiries solicited.

Write today for Catalog IS-700

COLUMBIA ELECTRIC MFG. CO.
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We asked a few Operators how they are doing with

ANGLE FLOW TUYERES

U. S. Pat. 2,124,437

Tuyere at top-center of illustration is Angle Flow type with refractory nose

Here's What They Reported . . .

Increased requests for the Angle Flow Tuyere, both with and without refractory nose, prompted us to check current results with angle flow installations. These operators enthusiastically reported greatly improved conditions, reduced burning after a switch to Angle Flow Tuyeres.

With tuyere pointed down (towards six o'clock) one operator reports his tuyere life increased from 24 days on conventional type to 100 days with refractory nose Angle Flow Tuyeres. Another who was getting from 30 to 35 days on a conventional type had had Angle Flow units with refractory nose in operation for 60 days and they still remained in the furnace. A third operator stated that he had been burning certain tuyeres nearly every day and that Angle Flow Tuyeres had apparently corrected this condition.

Other reports equally favored Angle Flow Tuyeres. There is every indication that this tuyere design, in Falcon quality casting, is capable of eliminating many troublesome, costly burning problems. Certainly they warrant a trial installation. Falcon is licensed to produce the Angle Flow Tuyere under U. S. Pat. No. 2,124,437 and is prepared to offer prompt delivery.

Telephone Collect 3-4186

FALCON BRONZE CO.
YOUNGSTOWN 3, OHIO
Established 1890 • Incorporated 1895

for Pittsburgh Piping and Equipment Co., Pittsburgh, Pa.

Foreign furnace contracts including design are: from South African Iron & Steel Industrial Corp., Ltd., at Pretoria, South Africa; Brazilian National Steel Co. at Volta Redonda, Brazil; and the Ilva Bagnoli plant in Genoa, Italy.

Rust engineers completed work on Inland Steel Co.'s coal washing plant at its Price mine, Wheelwright, Ky.; and carried on construction of roasted concentrate storage bins and other projects for Climax Molybdenum Co. at Langeloth, Pa.

Design and construction of industrial chimneys, a Rust specialty, included work on some 128 reinforced concrete and radial brick chimneys in many states, Canada, Puerto Rico, and Australia.

As a leader in the boiler setting field, Rust constructed more boiler settings in 1949 than any previous year. It has helped advance modern design trends in large utility boiler installations through pioneering the application of refractory to large radiant boilers by the "gunite" method. This work is done by Rust's own forces in conjunction with other refractory boiler work required on a job so that the company's own specialists can adequately supervise the installation.

HAMILTON PUMP CO. COMBINES TWO PLANTS

▲ Hamilton Pump Co. has recently combined two existing plants under one roof. All production is now concentrated in reconstructed plant quarters located at 39th St. and A.V. R.R., Pittsburgh 1, Pa., where much more floor area and greatly improved facilities will benefit manufacture of our specialty machinery for wet grinding strip and sheet. Through this move the company has equipped itself for building larger steel mill equipment and the handling of heavier machine production in general.

On December 1, 1949, the company also relocated at the new address, 32 Thirty-ninth St., Pittsburgh 1, Pa.

STEEL INDUSTRY AGAIN LOWERS ACCIDENT RATE

▲ The steel industry's safety performance, consistently the best in heavy industry, according to National Safety Council records, was highlighted with the presentation of two first place awards to steel companies at the National Safety Congress meeting in Chicago.

According to records of the Metals Section of National Safety Council, this was the fourth consecutive year during which the steel industry has lowered the accident frequency rate among its employees. During the twelve months ended June, 1949, steel companies set a new record in safety performance of fewer than six accidents for each million manhours of work.

Last year the steel industry topped all heavy industry in job safety and ranked fourth among all industries, light and heavy.

USE THE ENGINEERING MART!

Check the soil

and mail the coupon

What soils do you find most difficult to remove from metal surfaces? For free information about better metal-cleaning methods, mail the coupon to Oakite Products, Inc., 19 Thames St., New York 6, N. Y.

- ☐ buffing compound residues
- ☐ pigmented drawing compounds
- ☐ oils and greases
- ☐ carbon smuts
- ☐ heat scale
- ☐ flux residues
- ☐ rust
- ☐ rust preventives
- ☐ other soils: .....

Metal to be cleaned: .....

NAME .....

COMPANY .....

ADDRESS .....

SPECIALIZED **OAKITE**

INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

BROWNING MILL TYPE CRANES have *Plenty of Strength* WHERE STRENGTH IS NEEDED!

Browning Mill Type Cranes are built in accordance with A. I. S. E. specifications. They incorporate the types of motors and controls on which your mill or industry has standardized. This flexibility adapts your VRB crane *perfectly* to your needs. Only the finest materials are employed. Browning heavy duty cranes meet the most rigid demands and satisfy the most critical users. Our design, placing plenty of strength wherever needed, is the outgrowth of 48 years' experience in the crane industry.

"Built as you yourself would build them"

Write for our Bulletin "S".

VRB

VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

ELIMINATE STOOL STICKERS

with "NATIONAL" Graphite Stool Inserts!

*** Here are the conclusions drawn from five years of testing "National" graphite stool inserts:**

1. Cast-in graphite stool inserts eliminate stool stickers.

2. Cast-in graphite inserts, of proper grade and size, produce a stool which will outlast an ordinary all-iron stool by as much as 86%.

3. Cast-in graphite inserts do not adversely affect the quality of the steel ingot.

ADVANTAGES ARE:

Track time for ingot trains held to a minimum. Maintenance cost of stripper cranes materially reduced. Time and labor saved all along the line.

* Write for free reprint of "Graphite Stool Inserts for Big-end-down Molds" from the September, 1949, issue of *Iron and Steel Engineer*. Address Dept. IS

Use Carbon Mold Plugs for Plug-bottom Molds!

No contamination of ingot. • May be used more than once; no stickers. • Light, strong, easy to handle. • Consistently accurate in dimension. • Resist thermal shock and hot-metal erosion.

The term "National" is a registered trade-mark of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

30 East 42nd Street, New York 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Foreign Department: New York, U.S.A.

These products sold in Canada by Canadian National Carbon Company, Ltd., Toronto 4.

Personnel News...

V. H. Lawrence, vice president, plant development, employe and public relations, was transferred to the newly created position of vice president, planning and control for Jones and Laughlin Steel Corp. **W. R. Elliot,** formerly general superintendent of J&L's Otis works, has been elected vice president, employe and public relations. Mr. Elliot was born and educated in Canada. He began his experience in the steel business as a mill helper with Baldwin Steel Co., Ltd., of Toronto, Ontario in 1921. Coming to the Otis Steel Co. of Cleveland, Ohio, in 1925 as a foreman in the 30-in. cold strip mill, he progressed through various positions, becoming assistant to the vice president of operations in 1934. When the assets of the Otis Steel Co. were acquired by the Jones & Laughlin Steel Corp. on July 1, 1942, Mr. Elliot was named assistant general superintendent of the Otis works. He was promoted to general superintendent on May 1, 1947.

Stephen M. Jenks was named vice president in charge of operations, Carnegie-Illinois Steel Corp. Mr. Jenks succeeds **James E. Lose,** who was recently elected executive vice president. At the same time, the appointment of **William C. Oberg** to a new position as general manager of operations of Carnegie-Illinois was announced. Mr. Jenks has been manager of operations for the company's Chicago district. A native of Port Huron, Mich., he is a Cornell graduate and has been connected with U. S. Steel subsidiaries since 1925. From 1940 until March of last year, he was general superintendent of the Gary works, largest operating unit of Carnegie-Illinois.

Mr. Oberg, who has been manager of operations, Pittsburgh district, since 1935, has been associated with U. S. Steel since 1911. He started as a tool maker and template maker at the Homestead works. He is a native of Sweden and became a naturalized citizen of the United States in 1911. He attended public schools in Oshkosh, Wis., and continued his education at night classes of the YMCA and the Carnegie Institute of Technology in Pittsburgh.

H. L. Bills was elected vice president in charge of industrial relations for Acme Steel Co. Mr. Bills had previously served as director of industrial relations for Acme since 1937. Prior to his association with Acme, he had been a labor relations consultant for 16 years.

Elmer A. Schwartz was appointed district manager, Cleveland district of Republic Steel Corp. Mr. Schwartz who has 30 years of steel experience behind him succeeds **James L. Hyland** who has been in charge of the Cleveland district since 1939. Mr. Hyland has been named chairman of Republic's open hearth committee which coordinates open hearth steelmaking operations at all Republic's plants. Mr. Schwartz was born in Pittsburgh and joined Jones & Laughlin Steel Corp. in 1919 in its cold rolled and cold drawn steel department. In 1923 he went to the Brier Hill works of the Youngstown Sheet & Tube Co. in the mechanical department. In 1926, after a course of study in which he specialized in open hearth furnace operation, he went into the open hearth as a third helper and in 1938 had risen to the position of superintendent of the Brier Hill open hearth department. In 1940 he joined Republic and shortly thereafter was put in charge of the open hearth department in the Cleveland district. He was transferred to Youngstown in 1943 as assistant district manager and on July 1, 1946, went with Portsmouth Steel Co., Portsmouth, Ohio, as president.

Mr. Hyland, who has a national reputation as an open hearth expert, started with Carnegie Steel Co. at Duquesne, Pa., as a chemist. He joined Republic in 1930 as district manager of the Chicago district and remained there until 1939 when he came to Cleveland in a similar capacity.

K. A. D. Naoroji, who has been president of Tata, Inc., since 1945, returned to India where, as a director of Tata Industries, he will be located in New Delhi. Mr. Naoroji came to the U. S. A. originally in 1943, on loan from Tata, as director of supplies of the India Supply Mission in Washington, D. C.

Leo F. McCaffrey is now assistant general superintendent, Companhia Siderurgica Nacional, located at Volta Redonda, Estado do Rio, Brazil, South America. Mr. McCaffrey was formerly located in the Chicago district for the Allis-Chalmers Manufacturing Co., and later transferred to the Pittsburgh office of the same company, as special engineer, industrial sales.

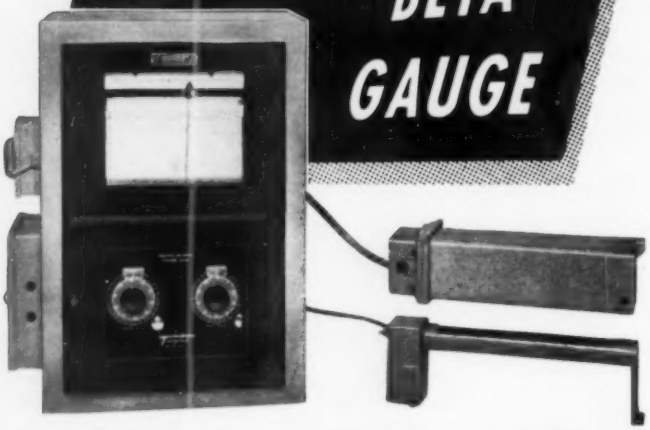
V. H. LAWRENCE

W. R. ELLIOT

WILLIAM C. OBERG

STEPHEN M. JENK

NEW TRACERLAB BETA GAUGE



FOR SHEET STEEL . . . . BRASS . . . . ALUMINUM

ELIMINATE OFF-WEIGHT REJECTS . . . . IMPROVE QUALITY CONTROL
SAVE RAW MATERIALS . . . . DECREASE VARIATIONS ACROSS SHEET

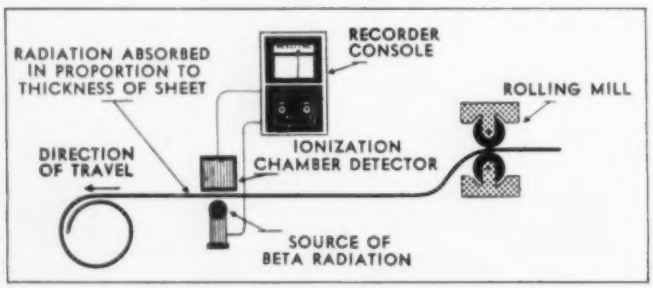
With this new non-contacting thickness gauge

The Tracerlab Beta Gauge is a completely new and unique instrument for measuring and recording thickness of continuous metal sheets directly on the production line. This gauge uses beta radiation from Oak Ridge produced radioisotopes to achieve a high degree of accuracy and sensitivity. It is a non-contacting type of gauge designed for the severe operating conditions usually encountered in production operations.

Another new gauge using beta ray backscattering is also available to measure metallic deposits, such as electrolytic tin plate or galvanized coatings, independent of the thickness of the base material.

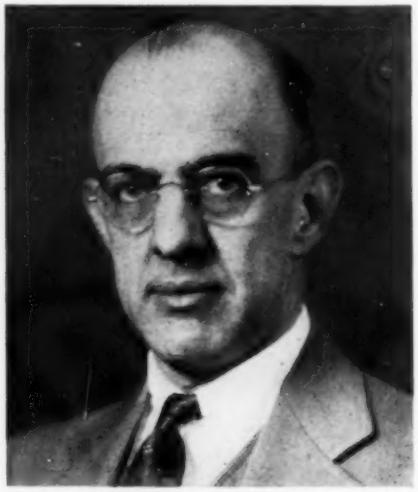
Let us know your problem and we will gladly advise you how Tracerlab Beta Gauges can help you.

Write for Bulletin E



Tracerlab
INC.
130 HIGH ST., BOSTON 10, MASS.

Frank W. Cramer has joined Elliott Co. as a consulting engineer to assist in the design, application, installation, maintenance, and sales of electrical apparatus to the steel and allied industries. He will have headquarters in Pittsburgh, Pa. Prior to this assignment,



FRANK W. CRAMER

Mr. Cramer had been with the Carnegie-Illinois Steel Corp. in Pittsburgh as electrical engineer since 1936. Formerly he had been with the Bethlehem Steel Co. in Johnstown, Pa., as assistant electrical superintendent and Republic Steel Corp. in Youngstown, Ohio, as chief electrical engineer.

During his 30 years' steel industry experience, Mr. Cramer has been active with both the Association of Iron and Steel Engineers and American Institute of Electrical Engineers. He is a past president of the AISE and has served as chairman of many committees over the years.

Orville R. Lyons was named coal preparation engineer for Heyl & Patterson, Inc., Pittsburgh, Pa. For the last four years, Mr. Lyons has served as research engineer in charge of coal preparation at Battelle Memorial

ORVILLE R. LYONS

Institute, Columbus, Ohio. Since receiving his bachelor of science degree from the University of North Dakota and his master of science degree from the University of Alabama, Mr. Lyons has been actively engaged in the coal preparation field.

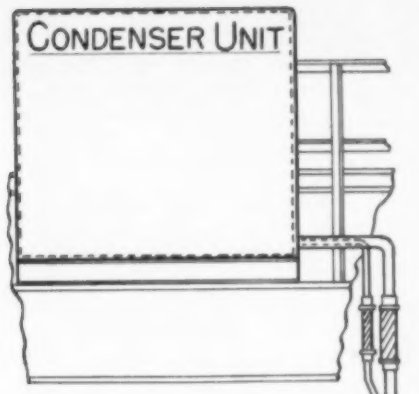
Frank W. Robertson is now a manufacturer's representative for several machinery builders. Mr. Robertson is located at 620 Penn Ave., Wilkinsburg, Pittsburgh 21, Pa. He was formerly associated with Harris Pump and Supply Co.

Merle J. Graham was appointed manager of production for Allegheny Ludlum Steel Corp. **Frank G. Benford,** assistant manager of the company's West Leechburg, Pa., plant, was named to succeed Mr. Graham as plant manager.

Walter F. Munford, who started with the American Steel & Wire Co. as a die-reamer thirty years ago, has been elected vice president in charge of operations of the company. In his new post, Mr. Munford takes the office vacated by **Harvey B. Jordan** who assumed the presidency of the wire company on January 1, of this year. Born in Worcester, Mass., June 8, 1900, Mr. Munford was educated in public schools there before entering Worcester Polytechnical Institute. Later, after serving in World War I, he transferred to Massachusetts Institute of Technology, where he earned his degree in mechanical engineering. During the summer

WALTER F. MUNFORD

vacation of 1919 he obtained his first employment with the company at North works in Worcester, after deciding in the course of his college studies that he wanted to make his career in the steel business. After leaving school, Mr. Munford became a helper in the open hearth department of the wire company in Worcester in 1923. In his progress up through the ranks he held several other positions before being made superintendent of open hearth in 1927. In 1930 he was transferred to Cleveland and was named superintendent of open hearth at the company's Newburgh works. Three years later when that division was dismantled, he was transferred to the National Tube Co., at Lorain, Ohio, as assistant superintendent of the steel works. In 1934 he returned to the wire company in Cleveland as assistant superintendent at Cuyahoga works, Cleveland, becoming superintendent in January, 1937. After a period as assistant to the vice president of the company in 1939, he was made assistant manager of operations of the Pittsburgh district in December of that year. In April of 1942 Mr. Munford was named manager of operations of the Worcester district from which post he moved to assistant vice president in charge of operations under Mr. Jordan three years later.



COOLING EFFICIENCY INCREASED 30%

LINTERN AIRE-RECTIFIER

In these new Aire-Rectifiers — of the "split" unit type — troublesome and expensive air ducts have been eliminated and cooling efficiency increased as much as 30% in the cab.

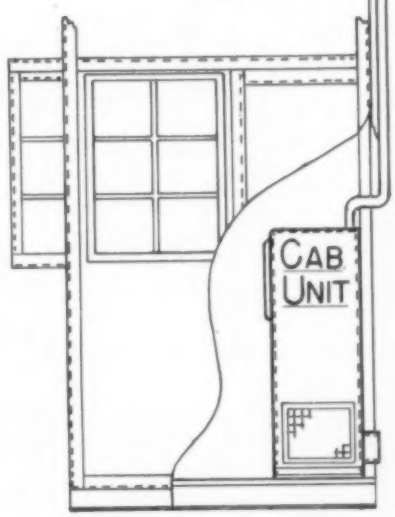
The condenser is located at any convenient place on crane and evaporator (cooling coil) is placed in cab. The two units are connected with refrigerant lines properly secured and protected against breakage. Condensers are air-cooled, assuring trouble-free service with but little maintenance.

These Aire-Rectifiers will hold properly insulated cabs at a cool 85° F and relative humidity of 30% to 50% at ambient temperatures of 170° without excessive head pressures or wear on the machine.

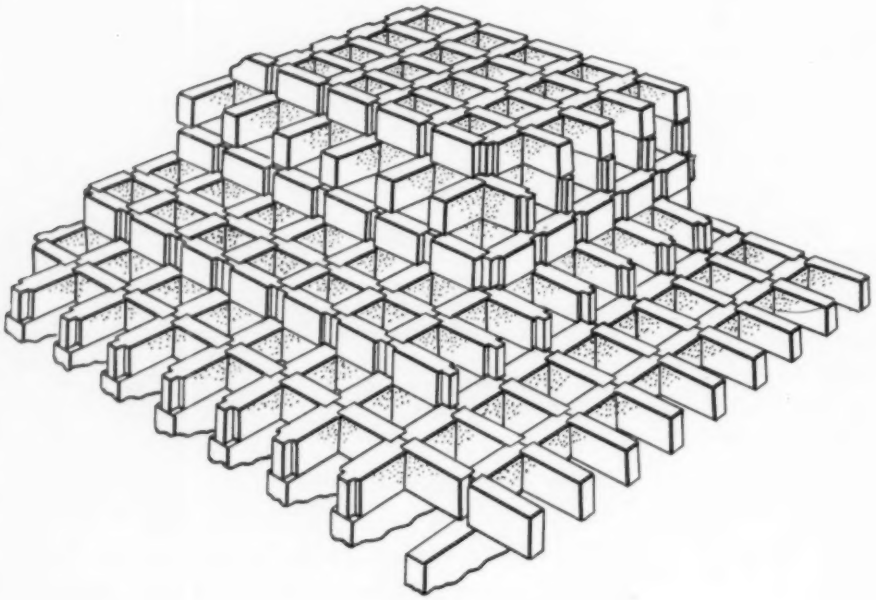
THE LINTERN CORPORATION

54 LINCOLN AVENUE • BEREA, OHIO

Send for new bulletin AC 4912, just out, containing complete information.



Let's Keep the Record Straight!



THIS IS OUR WALTERS SOLID FLUE CHECKER WORK

A refractories manufacturer has implied in their advertising to the steel industry that the checkerwork shown above is covered by an existing patent, known as Hiller-Weber Patent No. 2,303,741.

It is not true that the Walters checkerwork infringes the Hiller-Weber patent, nor does the Hiller-Weber patent cover the checker work shown above, which is known as the Walters solid flue checker. In order to refute this implication we wish to quote from an opinion* of our patent counsel:

> "The Walters checkerwork is not covered by and does not infringe the Hiller-Weber Patent No. 2,303,741. The single claim of that patent is expressly limited to three shapes of tile set in a particular manner and therefore does not cover and cannot be construed to cover a checkerwork in which only two shapes are used and one entirely omitted. The use of two shapes of tile instead of three is a departure from the claim of the Hiller-Weber patent and is not covered by that patent."

The Walters checker is priced at the present market price of brick, $86.00 per thousand, for both straight and special shapes (9 inch equivalent). The special shape is the same price as the straight.

The Walters checker gives the same size solid chimney flue as obtained with the 18 in. brick, laid basket weave, but eliminates the extra carried by the 18 in. brick.

*Copy of opinion will be furnished upon request.

UNION FIRE BRICK COMPANY

507 OLIVER BUILDING **PITTSBURGH 22, PA.**

Ernest S. Kopecki has recently joined the Pennsylvania Salt Manufacturing Co. as a sales service representative in the special chemicals department. Coming to Pennsalt with extensive experience in the field of metallurgy, Mr. Kopecki earned his degree of bachelor of science in chemical engineering at Marquette University and his master's degree in metallurgy at Carnegie Institute of Technology.

John C. Hampson, former Indiana field representative for the Pennsylvania Salt Manufacturing Co. special chemicals department, has been named sales manager for the department's newly-formed Chicago district.

F. F. Brooks, Jr., was elected vice president and general manager of United Engineering and Foundry Co.'s subsidiary, Lobdell United Co., Wilmington, Del. He was also made a director of Lobdell United. Mr. Brooks started with United on October 3, 1927, in their Pittsburgh office. On September 8, 1942, he went to their Frank Kneeland plant in Pittsburgh as assistant superintendent. On November 15, 1944, he was moved to their New Castle plant as assistant superintendent.

J. K. Beidler, former purchasing agent, became assistant general manager of the machinery division, Dravo Corp. **R. M. Rush** was named manager of sales development; **H. M. Graham,** manager of the apparatus department; **D. R. Berg,** manager of the heating department, and **B. B. Reilly,** manager of air conditioning and combustion department. **G. P. Smith** was appointed purchasing agent to succeed Mr. Beidler.

Guy A. Baker has been appointed vice president in charge of manufacturing, for Duriron Co., Inc., Dayton, Ohio. For several years Mr. Baker has been assistant to the president and secretary of the company. Prior to that he has been manager of the Duriron Co.'s alloy castings sales.

R. Merton Shields has been appointed secretary of Duriron Co., Inc., Dayton, Ohio. Mr. Shields is a mechanical engineer, a graduate of Michigan College of Mining and Technology and prior to his new appointment was manager of the Dayton district sales for Duriron. He has been with the company since 1936.

Edward G. Fenton has been named superintendent of the Alan Wood Steel Co. hot rolled strip mill at Conshohocken, Pa. Mr. Fenton had been superintendent of the company's Schuylkill Iron Works since 1936, a post to which he was named shortly after he joined the Alan Wood organization. He has been connected with the steel industry since 1915 when he started work in steel mills in Ohio.

Carl F. Norberg was elected executive vice president of Electric Storage Battery Co., Philadelphia, Pa. He was formerly vice president in charge of manufacturing since 1944.

Elwood Broadwater was named director of public relations for the Salem Engineering Co., Salem, Ohio. Mr. Broadwater recently accompanied Salem Engineering's president, **Sam Keener,** on his four-and-a-half month business flight around the world in his private DC-4 Skymaster. Mr. Broadwater joined the WCMW staff in Canton, Ohio, in November, 1948, when he resigned as city editor of the Canton Repository, ending 12 years of service with Brush-Moore Newspapers, Inc. Thirty-one years of age, Mr. Broadwater was in Europe in 1946 and 1947 as operations officer of one of the U. S. occupation army's six counter-intelligence zones in Germany.

Clyde M. Horan has been transferred from Indiana Harbor, Ind., to the Youngstown, Ohio, district as

CLYDE M. HORAN

superintendent of Youngstown Sheet and Tube Co.'s blast furnaces at Campbell and Hubbard, succeeding **D. P. Cromwell,** who resigned to take a position as assistant manager of the blast furnace and coke oven department of Ford Motor Co. For the last nine years Mr. Horan has been superintendent of blast furnaces at the company's plant in Indiana Harbor. Widely known as "Red," Mr. Horan was born in McKeesport, Pa., raised in Duquesne, Pa., and attended Carnegie Institute of Technology. He was employed at the Duquesne works of Carnegie Steel Co. before he joined Youngstown Sheet and Tube Co. April 15, 1929 as a practice engineer at Campbell. He advanced to blower, general foreman, and assistant superintendent, then was transferred to Indiana Harbor.

E. E. Bauer, former manager of the central district for Peerless Pump division of Food Machinery Corp., with offices in Chicago, has joined the Pittsburgh office of Clark Controller Co. Mr. Bauer is a mechanical en-

E. E. BAUER

gineering graduate of the University of Wisconsin, and received his master's degree at the University of Pennsylvania.

James F. McCartney has been appointed general

When detecting temperature by radiation method . . .

● ***Quick-sighting optical system*** **lets user select desired target easily, and then check the sharply-defined area which the Rayotube sees. Increased sharpness is also of benefit when radiation comes from end of a closed tube.**

● ***Hermetically sealed construction*** **at lens, window, and leadwires keeps out dust and gases. New design guards inherent accuracy and stability, even with high or rapidly changing Rayotube housing temperatures.**

Which do you want?

If you already know about Rayotubes, we'll send you brief material to bring you up-to-date on the new model. If you want the full story on all Rayotubes, ask for Cat. N-33B. Please specify. Write Leeds & Northrup Company, 4942 Stenton Ave., Phila. 44, Pa.

Built to work with all Micromax and Speedomax Rayotube instruments, this new Rayotube is an important advance in radiation pyrometry. Present users of Rayotubes, as well as future ones, will find this completely new, advanced design detector unusually easy to apply, especially to such equipment as slab furnaces, soaking pits, open-hearths, ceramic kilns . . . wherever operating conditions are severe.

Purposely designed for easy, low cost replacement, the new Rayotube fits all existing Rayotube mountings. This unit requires no protection against high ambient temperature unless its housing temperature exceeds the very high figure of 350 F. Below that point, any previously installed water- or air-cooling can simply be turned off or disconnected.

Temperature control engineers will welcome these and many other new concepts of design built into this highly versatile temperature detector.

MEASURING INSTRUMENTS - TELEMETERS - AUTOMATIC CONTROLS - HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad NS3(1)

sales manager of Duff-Norton Manufacturing Co., Pittsburgh, Pa. Mr. McCartney will be in charge of all industrial, mining and railroad sales of Duff-Norton jacks.

Donald A. Clark, Lockport, N. Y., has been appointed to fill the unfinished term of vice president of the Electric Metal Makers Guild, Inc., made vacant by the resignation of **E. J. Chelius**.

Arnold L. Horelick was appointed as engineering manager and **John J. Zimsky** was named chief mechanical engineer of Pennsylvania Transformer Co., Pittsburgh, Pa. Mr. Horelick has been affiliated with the Pennsylvania Transformer Co. since 1938 in a number of capacities, including mechanical and electrical designing, sales engineering and assistant to the president. John J. Zimsky, a registered professional engineer, has been affiliated with Pennsylvania Transformer Co. since 1929. Prior to that, he was employed by the former Pittsburgh Transformer Co.

Wayne D. Staley, formerly New York district manager for Duriron Co., has been appointed general sales manager and will be located at the home office of the company in Dayton, Ohio. In directing sales and advertising activities, he will replace **D. E. Jack,** who has resigned as vice president in charge of engineering and sales. **R. F. Sharpe,** former manager of the Philadelphia office, has been appointed New York district manager. **Ralph L. Watts,** who was formerly sales engineer in New York, will be in charge of the Philadelphia, Pa., office.

H. M. Rich, Jr., was named general sales manager of the Electro Metallurgical division of Union Carbide and Carbon Corp. Mr. Rich joined the corporation in 1942 after 10 years with Hickman Williams and Co., in Detroit, Mich. From 1943 to 1948, he served as New York district manager of Electro Metallurgical and in 1948 he was appointed division manager of the New York and Birmingham territories. Mr. Rich will continue to make his headquarters in the general offices in New York.

Albert T. Lawson has been appointed vice president, general services, of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. The position is newly created. Mr. Lawson will take over his duties March 1. Mr. Lawson joined J&L in 1915 and since August, 1947, has been general superintendent of the corporation's Pittsburgh works. He will be succeeded in that position by **J. A. Lambing,** assistant general superintendent of the Pittsburgh works since July, 1948. Mr. Lambing joined J&L in 1924 at the Aliquippa works. He was transferred to the Pittsburgh works in 1937.

Avery C. Adams will become president of Pittsburgh Steel Co., Pittsburgh, Pa. **Joseph H. Carter,** president since 1942, will step up to chairman of the board and chief executive officer. Mr. Adams has been executive vice president of Detroit Steel Corp. since January 1. Detroit Steel purchased Portsmouth Steel Co. of which Mr. Adams had been vice president since 1949. Previously, he was vice president in charge of sales of U. S. Steel Corp. He also was a member of the executive committee and board of directors of Big Steel.

Before becoming U. S. Steel vice president in 1939, he was vice president and assistant general manager of sales for Inland Steel Co.

Prior to that time he had been manager of sales, sheet division Carnegie-Illinois Steel Corp., after serving as a sales executive with Trumbull Steel Co., Republic Steel Corp. and General Fireproofing Co.

Mr. Carter, like Mr. Adams, is a former Youngstown steel man. He came to Pittsburgh Steel in 1936 from Sharon Steel Corp., where he had been general superintendent of the Lowellville works. He was made general superintendent of Pittsburgh Steel and in 1937 became vice president and director. He took over the helm five years later.

James P. Stewart, vice president and manager of commercial sales division of De Laval Steam Turbine Co., has been elected executive vice president. Mr. Stewart will continue as manager of the commercial sales division. **W. A. Reynolds,** manager of the "IMO-De Laval" products division, has been appointed assistant to the president. **W. A. Neumann, Jr.,** controller of the company, has been appointed acting manager of the "IMO-De Laval" products division, but will retain the title of controller, having been appointed to that office in January, 1949.

John P. Critchlow has been appointed chief fuels and lubricants engineer, rolling mill section, industrial products engineering, Gulf Oil Corp., Pittsburgh, Pa. Mr. Critchlow is a mechanical engineering graduate of Carnegie Institute of Technology and joined Gulf in 1947 as a lubrication engineer. Prior to joining Gulf he had been associated, for a period of thirteen years, with the Mesta Machine Co., Pittsburgh, Pa., as a rolling mill design engineer.

S. W. Rolph, executive vice president, Electric Storage Battery Co., Philadelphia, Pa., has been elected president to succeed **R. C. Norberg,** who has been elected chairman of the board.

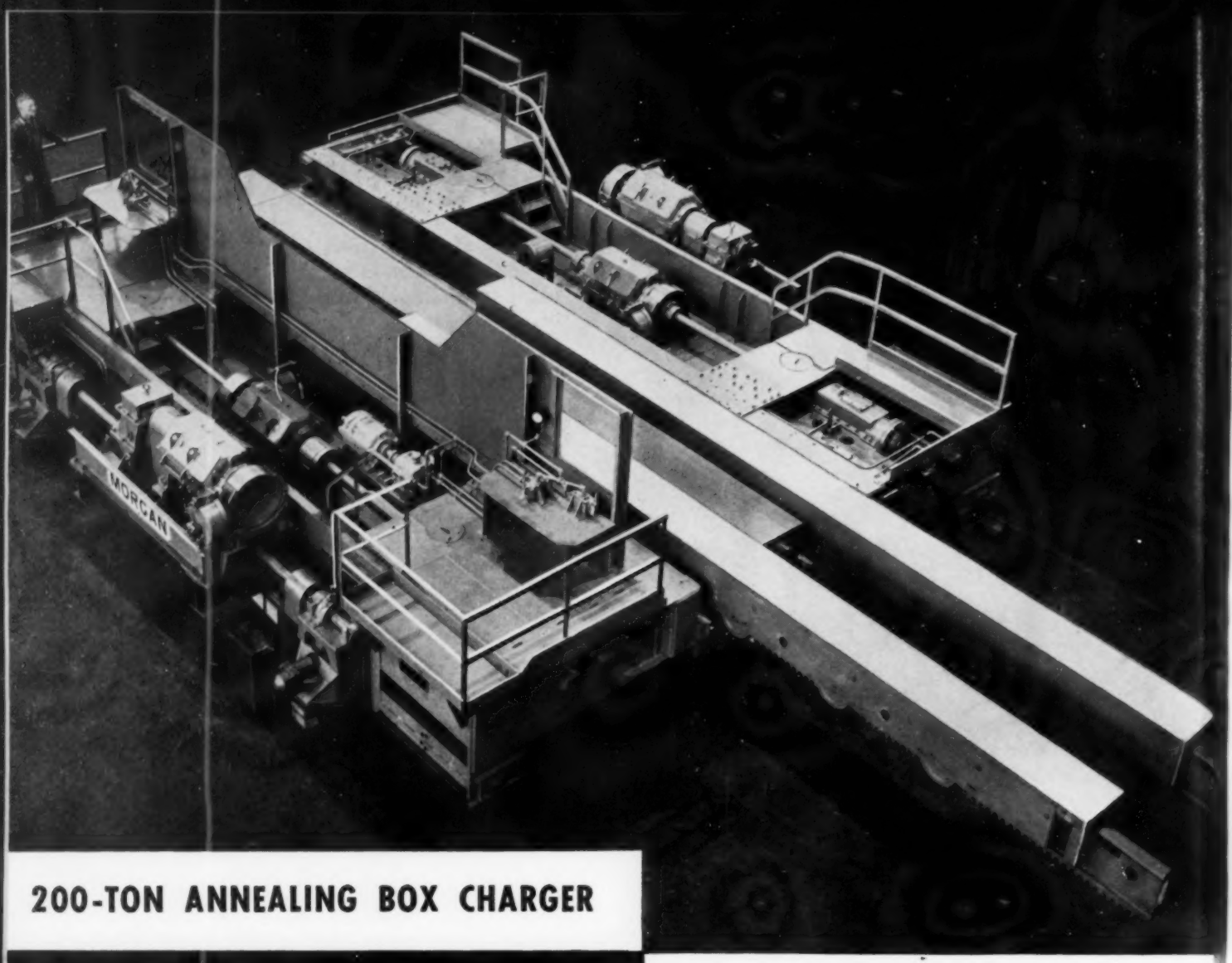
Obituaries

David A. Wolff, 59, business development manager, Edwin L. Wiegand Co., Pittsburgh, died December 30, following an illness of several months. During his entire business life he was engaged in advertising and sales promotion activities, and he joined the Edwin L. Wiegand Co. in 1934 as advertising manager. He was appointed in 1947 to the position he held at his death.

Joseph J. Milton, 63, a structural engineer for the United Engineers and Constructors, Inc., died January 10, 1950.

Robert Chalmers Todd, 68, former vice president of Armco Steel Corp., passed away January 19 after suffering a heart attack in Middletown, Ohio.

Albert B. Cudebec, 72, vice president of Hydropress, Inc., New York, N. Y., died suddenly of a heart attack on January 28, 1950 in Philadelphia. Born in Nunda, N. Y., in 1878 he was a graduate of Cornell University. After service in World War I he was appointed by leading American and French banks as a technical and industrial adviser. In 1937 he joined Loewy Engineering Co., Ltd., of England, who delegated him as their representative and trustee to the U.S.A. In 1940 he became vice president of Hydropress, Inc., of New York, with whom he remained associated until his death.



200-TON ANNEALING BOX CHARGER

BUILT BY MORGAN Engineering

Illustrated is a Morgan 200-Ton, 5-motor, 19′-3½″ Span Annealing Box Charger. It consists of a traveling bridge upon which are mounted two rack driven charging trucks operating in unison for raising the annealing boxes and moving them into or out of the furnace or onto the cooling beds. The charging trucks are operated by two motors through four worm units with provision for operating either of the two motors alone.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

Equipment News...

SECONDARY MILL SCALE REMOVED WITH WIRE WHEEL POWER BRUSHES

▲ A new process, developed by one of the mid-west's largest steel producers, for the removal of secondary scale from flat steel shapes has proven successful and is now being used in full time operation.

Mill scale, or what might be called primary mill scale, results from the steel being heated in furnaces prior to rolling. It is removed by hydraulic water pressure in the rolling mill line. About 1 per cent of the weight of the steel is lost in the hydraulic removal of furnace scale. In a hot mill, the secondary mill scale can be removed by brushes. This process removes about one-half of one per cent of the weight of the steel.

Special machinery has been developed by this steel producer whereby the secondary scale is removed with disc-center wire wheel brushes manufactured by Osborn Manufacturing Co., Cleveland, Ohio. The brushes are driven by a two horsepower motor which runs at about 1400 revolutions per minute with a three-to-one gear reduction, (Fig. 1).

This brush is constructed for high speed, heavy duty operations such as scale removal. It is an Osborn No. 1108 disc-center wire wheel brush 8 in. in diameter. It is constructed of heavy knots of .016 steel wire which are individually secured in a one-piece steel center.

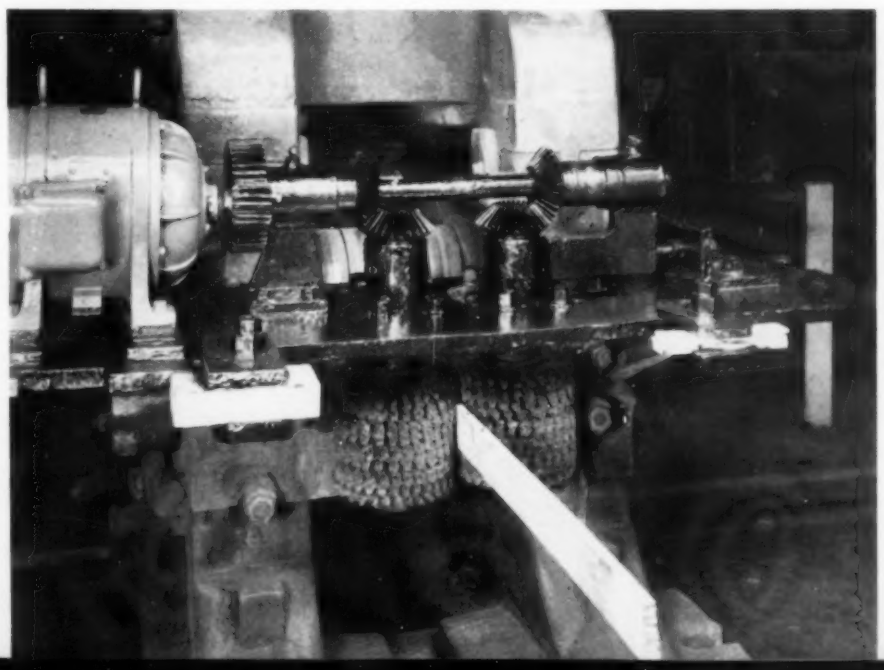
The pieces of steel come through the mill and are run through the machine against the direction of the brushes. The scale removed is the secondary scale that develops during the rolling operation as contrasted with the furnace scale that develops when the steel is heated in the furnace just before rolling.

The Osborn brushes are used on both the 8-in. and 10-in. bar mills. Not all the material on the mill goes through the brushes. Approximately 19 per cent of the material on the 8-in. mill and 36 per cent of the material on the 10-in. mill are brushed. As the brushes wear down, one of the shafts is moved closer to the other.

The steel travels 800 to 1200 fpm on the 8-in. mill and 700 to 1000 fpm on the 10-in. mill. The brushes operate in a water spray, which is used mainly to keep them cool so that they maintain their effectiveness. The steel has a temperature of 2050 to 2200 F when it comes out of the furnaces, and runs from 1800 to 1925 F while it is being finished and run through the brushes.

This bar mill consists of ten rolling stands. The brushes are used after the seventh stand and after the ninth stand. The mills where the brushes are used are hot bar mills, as contrasted with sheet mills, either hot or cold rolled. Pickling, another method for removing scale, is used principally in connection with a cold mill, and is a separate line after the rolling process. Pickling removes about .00075 in. from the surface.

Scale removed is the secondary scale that develops during the rolling operation.



ONE-TIME FUSE FOR POSITIVE PROTECTION

▲ Due to the heavy demand of industry for a one time "N.E.C. Non-Renewable Fuse," Ware Fuse Corp. has added a complete series of powder packed fuses in 250 and 600 volts and from 3 amperes to 600 amperes.

These one time fuses are filled with a commercial composition to cut down the arc and eliminate the flash through cases when fuses blow. The fuses are inexpensive for one time use where positive electrical protection is desired.

The fuses are durable and rugged in construction. The knife blade type has tamper-proof drive screws to hold caps securely. Knife blades are held in perfect alinement to insure good contact and efficiency.

The ferrule type assures efficient operation by concentrating heat to center of fuse and holding heat loss at clips to a minimum.

OHIO ELECTRIC ADDS DIVERSIFIED DIVISIONS

▲ Ohio Electric Mfg. Co. has purchased all assets except plant of the Wright hoist division of the Lisbon Hoist and Crane Co., of Lisbon, Ohio.

The "Bob-Cat" hoist will be manufactured in the Ohio Electric plant in Cleveland, with full production scheduled for early April. Distribution will be through Ohio's own nation-wide sales force and mill-supply houses.

Since the "Bob-Cat" cable hoist is of the electric motor type, the product provides a further outlet for Ohio's electric motor division. Present sizes of the hoist range from 5-ton down to ½-ton capacities. Ohio's engineering staff is already developing plans for expansion of the line to even smaller capacity hoists.

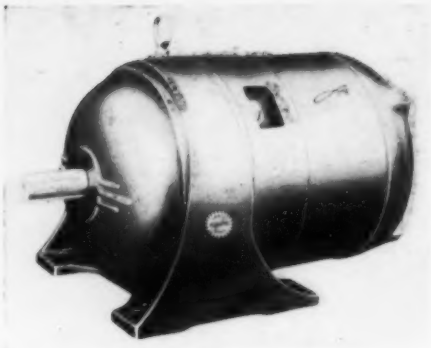
Ohio Electric has also purchased the nail making machine business of Black Industries, Inc., Cleveland.

Black Industries has been one of the nation's largest producers of wire nail making machines. Ohio Electric is taking over all business on hand and will continue delivery of machines and spare parts to Black's former customers.

JOINT PROGRAM ON NEW GEARMOTORS

▲ Foote Bros. Gear and Machine Corp., Chicago, Ill., and Louis Allis Co., Milwaukee, Wis., have recently announced a joint program for the manufacture and sale of a complete line of gearmotors.

The new gearmotor makes use of



hard helical gears and other moving parts which have been processed and heat treated under new and improved methods of manufacturing control. These methods have produced new high standards of performance with regard to load carrying capacity, wear life, quietness of operation and compactness of design.

The new gearmotor, manufactured in 17 sizes, provides single, double and triple reduction units having output speeds from 780 rpm down to 7.5 rpm. Integral horsepower ratings from 1 through 75 hp are available for practically any industrial application.

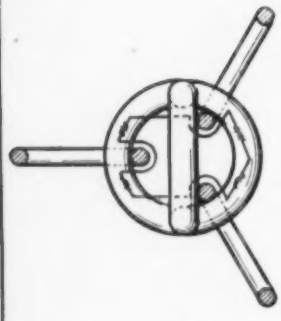
A wide selection of motor enclosures is offered, including the conventional open drip-proof, splash-proof, totally enclosed and explosion-proof construction. A-c and d-c motors of all types, as well as motors having special electrical characteristics, are available to meet unusual installation and application requirements.

STEAM TURBINES FOR LOW-SPEED APPLICATIONS

▲ Industrial steam turbines with close-coupled, integral reduction gears for low-speed applications (Type E) are available from Westinghouse Electric Corp. Equipment such as pumps, fans, compressors, and generators can be driven at their proper speeds by these gearturbines while the turbines operate at their most efficient speed.

The new units combine a rugged, compact speed reduction mechanism solidly coupled to the turbine and designed to operate as a single unit. Three machined feet form a firm three-point support for the unit. Single helical gears with low helix angle give low thrust against bearings.

the MOST ECONOMICAL
SUSPENSION CHAIN
for hard, fast working magnets



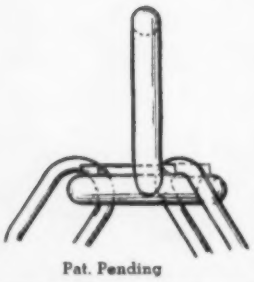
Heat-treated high alloy steel PLUS the patented ring to eliminate rubbing and twisting gives Downtown Frictionless Magnet Suspension Chains up to 3 times the life of old-style suspension chains.

Locating Plate keeps magnet face level.

No more periodic annealing.

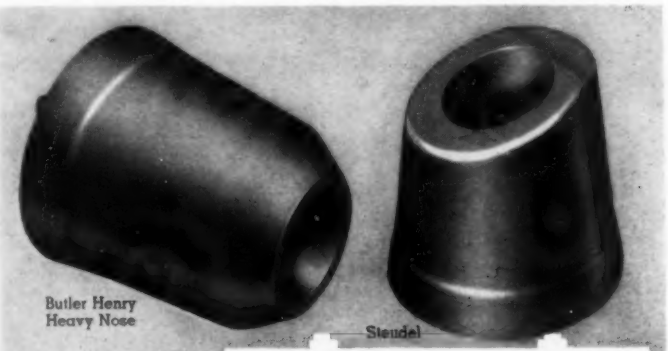
For these reasons Downtown Suspension Chains offer you best dollar value.

Each chain for 55 inch magnets is tested to 89,000 lbs. Each chain for 65 inch magnets is tested to 115,000 lbs. Don't delay! Write now for prices. Prompt shipment from stock.



Pat. Pending

DOWNTOWN Company
1836 EUCLID AVE. • CLEVELAND 15, OHIO

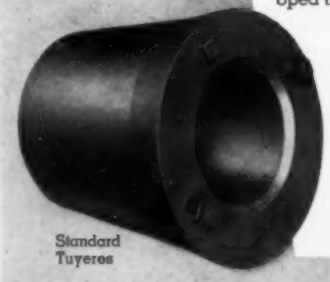


Blast Furnace
TUYERES

Made to quality standards developed through years of specialization in the manufacture of Blast Furnace Copper Castings.

Licensed manufacturers of all leading designs.

Phone, wire or send specifications for estimates.



SMEETH-HARWOOD COMPANY
2401-09 West Cermak Road, Chicago 8, Illinois
Superior Blast Furnace Copper Castings *Exclusively*

A NEW ENGINEERING MATERIAL:

Ductile castings

SOMETHING NEW IN THE CASTING INDUSTRY

What is DUCTILE IRON? It is an invention relating to a unique alloy that contains the best features of gray cast iron, malleable iron and steel, with much better physical properties.

DUCTILE IRON IS NEW. Patent was applied for in 1947, and granted October 25, 1949. It is so new that engineers may spend years checking its undeveloped possibilities, qualities, properties and applications. In the "as cast" condition it has a combination of properties of an order entirely different from and higher than that obtained in gray cast iron and steel.

Consumers of ferrous alloy castings, and men who specify the engineering materials will be interested in DUCTILE IRON because: it has a tensile strength of 75M to 90M PSI—elongation 2% to 10%—yield point 55M to 65M lbs.—Brinell hardness 175 to 300—modulus of elasticity 25,000,000 lbs.

Illustration suggests the extreme ductility of DUCTILE IRON. This bar, ½" x ¼" as cast, was twisted cold—and it emits a definite, steel-like ring when struck.

DUCTILE IRON has excellent founding properties, can be readily cast into molds of intricate design, and has better castability than steel. It has unique elastic properties not possessed by gray iron and can be cast in heavier sections than malleable.

DUCTILE IRON may be applied to the manufacture of a wide variety of ferrous products and articles usually made of such ferrous alloys as gray cast iron, pearlitic malleable iron, ferritic or standard malleable iron, and cast steel.

We are licensed to furnish the steel industry castings with the above properties. Send us your drawings and inquiries, and we will show how you can profit by using the revolutionary DUCTILE IRON in YOUR products. Licensed under patent from the International Nickel Company.

TYPICAL APPLICATIONS:

DIES • ROLLING MILL HOUSINGS • APRON PLATES • GUIDES • TABLE ROLLERS • TABLE GIRDERS • GEAR BOXES • COUPLING BOXES • SPINDLES • RAILROAD EQUIPMENT • PRESSURE CASTINGS FOR VALVES, PUMPS • FURNACE PARTS • MELTING AND HEAT TREATING POTS • COMPOSITE PRODUCTS • MACHINE TOOL CASTINGS • CYLINDERS • PLUNGERS • SLAG LADLES

YOUNGSTOWN FOUNDRY & MACHINE CO.

YOUNGSTOWN 1, OHIO

Endwise movement of one shaft does not affect axial location of the other and thrust is not transferred from the gears to the turbine. Turbine and gear are factory alined on a single, heavy plate steel base which also serves as an oil tank. Additional steel members maintain rigidity and resist torsional distortion. The gearturbine is shipped as a completely assembled unit ready to install.

Gearturbines are available with standard gear reduction ratios for the best operating speeds of the usual types of loads.

The adjustable feature eliminates necessity for changing slings on cranes.

ADJUSTABLE PLATE SLING SPEEDS PLATE HANDLING

▲ An adjustable plate sling, designed for handling steel plates in 4, 5 or 6 ft widths, is announced by Woodhouse Chain Works. Adjustment is made possible by locating the heat-treated alloy hook in different end links. This permits constant maintenance of the 45-degree chain leg angle, thus preventing overloads.

This adjustable feature eliminates the necessity for changing slings on warehouse cranes to accommodate various plate widths. Consequently, it effects substantial savings in manhours and reduces the number of slings which must be stocked by users.

Safe working capacity is 8800 lb. Hooks are so designed that the full rated load can be lifted on the points.

In addition to their availability from the Woodhouse Chain Works, the new adjustable plate slings may be secured from Bridgeport Chain & Mfg. Co., Bridgeport, Conn.; Cleveland Chain & Mfg. Co., Cleveland, Ohio; Round California Chain Co., So. San Francisco and Los Angeles, Calif., and Seattle Chain & Mfg. Co., Seattle, Wash.

TUBULAR HEATERS USED ON STORAGE TANK PIPING

▲ Brooks Oil Co. in Cleveland, Ohio, manufacturer of extreme pressure lubricants for heavy industrial machinery, remedied a high-cost manufacturing problem by installing General Electric "Calrod" tubular heaters on storage tank pipe lines. During manufacturing this heavy compound oil flows through a series of temporary storage tanks. Because of its high resistance to flow a temperature of 375 F must be maintained to keep the oil moving freely through the tanks. Steam heat under pressure was formerly used to heat the tanks and pipe lines. Operating costs were high due to high heat loss and uneven heat distribution.

The formed tubular heaters have now been clamped to the base of each tank. Heaters have also been wound around the pipe lines and covered with protective layers of sheet metal and asbestos, cutting heat loss to a minimum. Thermostatic control now

Introducing the New
"Luminum-Line"
Plate and Pipe Marker

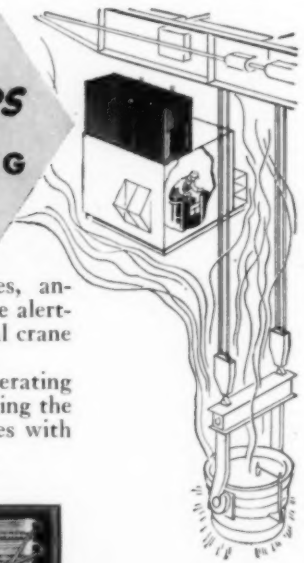
This new "Safety" steel stamp holder of cast aluminum is "easy on the operator" . . . gives long-life, rugged and dependable service . . . for all heavy-duty plate and pipe marking.

Write today for data and proposal!

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS

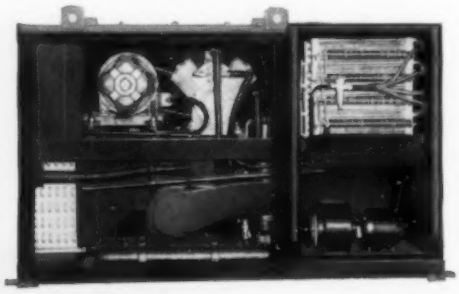
105 East Carson Street • Pittsburgh 19, Pa.

DRAVO
CRANE CAB COOLERS
REDUCE OPERATING HAZARDS



● Excessive heat, obnoxious fumes, annoying dust and moisture reduce the alertness and efficiency of your hot-metal crane operators.

● You can eliminate these crane operating hazards by completely air conditioning the cabs on all types of hot-metal cranes with Dravo Crane Cab Coolers.



Completely self-contained Dravo Crane Cab Cooler requires electrical connection only.

DRAVO CORPORATION
PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK
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Sales Representatives in Principal Cities

DRAVO

The heaters are clamped to the base of each tank.

provides even distribution of heat throughout the pipe lines.

Typical market for these mineral-based, compounded lubricants is the steel industry. Machinery used in mill operations requires extreme pressure lubricants to withstand the heat and water under conditions of heavy pressure.

By using electric heat, Brooks Oil Co. has reduced its requirements for high-cost steam heat.

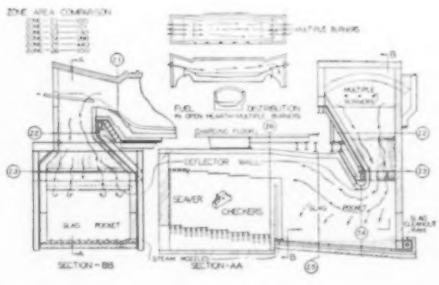
SEAVER DEVELOPS IMPROVED OPEN HEARTH

▲ An improved open hearth furnace design has been developed by Jay J. Seaver Engineers which features a suspended refractory deflector for the removal of heavy solids from combustion; multiple burners for greater efficiency; large, self-sealing charging doors and cross-vent basket weave, locked checker brick with smaller openings and larger heating surface.

The refractory deflector over the slag pockets in the Seaver design compels the products of combustion to make a 180 degree turn. This turn causes them to be thrown into the slag pockets by a combination of centrifugal force and gravity and eliminates the deposit of the solids in the checker chambers, and lancing. Regular removal of deposits is convenient and easy.

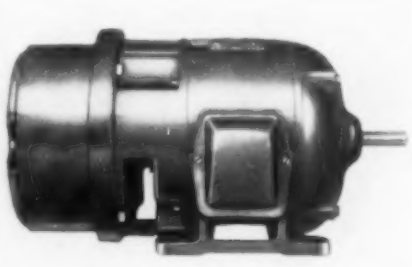
The multiple burners give maximum fuel efficiency because of greater fuel air contact surface and also provide flexibility of control. Multiple burners also promote faster heat transfer to the bath with sharp, accurately directed flames. These features permit a shorter melt-down period and fuel saving.

A suspended refractory deflector is featured in this new design.



BRAKEMOTOR USES METAL BRAKE LINING

▲ The new Crocker-Wheeler brakemotor offers compactness, simplicity of design, and complete dependability for applications requiring frequent instantaneous stopping and starting. Outstanding features of this new brakemotor are the prelubricated for life cartridge bearings and a new brake lining that eliminates the need of adjustments, making the unit ideal for use in inaccessible locations. Heart of the new unit is the recently developed Crocker - Wheeler brake which can be mounted on drip-proof, splashproof, or totally-enclosed motors to make a matched brakemotor in ratings from 1-60 hp.



Metal brake linings provide greater wear resistance in this new brakemotor.

One of the outstanding advantages of the new brake is the use of bonded metal brake linings. These metal linings are not affected by heat, cold, dampness, salt water, fungi, grease, or oil. The all-metal construction of the brake discs provides greater wear resistance, eliminating adjustments and replacements for all normal applications.

The new brakemotor is available separately for mounting on NEMA Standard D flange motors in frames 203-326 or C face motors in frames 364-405 with standard double shaft extensions.

CAR SHAKER UNLOADS WITHOUT UNCOUPLING

▲ To augment its present line of car unloaders, Link-Belt Co. now announces the development and production of a sturdy, compact, self-contained vibrator unit, called the Link-Belt car shaker, designed for the rapid, economical unloading of bulk granular materials from open top, hopper-bottom gondola cars to conventional track hoppers serving bulk materials conveying equipment.

Cars need not be uncoupled while the shaker is in operation. This permits the movement of cars through the unloading zone as a complete train. Cars are moved into place over conventional track hoppers in the usual manner with the aid of car hauls, spotters, switch engines or other means. After the car gates have been opened, the car shaker, which is normally suspended from a hoist, is lowered to the top of the car to begin its operation.

Rotation of the shaker's vibrator shaft at normal speed causes the vibrator-end of the shaker to rise and fall, and impart heavy hammer-like blows to the car, equal in number to the speed of the vibrator shaft.

The energy of these impacts on the vertical car sides is transmitted directly to the sloping portions of the hopper-car bottom, producing the most effective action where it is needed for loosening and unloading material.

The shaker pivots on the car top, on shoes which act as guides to maintain the position of the unit on the car.

The shaker is usually located at the center of the car, imparting equal vibration to both ends.

The shaker eliminates the destructive use of picks, augers, sledges or air hammers to shake the material loose; and its low-frequency vibration imparts no greater stresses to cars than does their rolling along the road bed.

One of the principal features of the car shaker is its low frequency of vibration. This results in relatively quiet operation.

Normal operation permits average conversation at a distance of 100 ft from the machine.

Whitcomb 50-ton Diesel electric locomotive designed specifically for steel mill operations, one of six identical Whitcombs now in service at this leading steel plant.

Fueling an 80-ton Diesel electric locomotive at an eastern steel plant. Fuel economy is an important advantage of Whitcomb Diesels, along with high availability, low maintenance costs.

At Scullin Steel, a 50-ton Whitcomb Diesel locomotive delivers inbound cars of scrap and materials to the 100-acre plant of Scullin Steel Company, St. Louis, Mo.

Whitcomb 35-ton Diesel electric locomotive, narrow gauge, in operation at the Ohio Works (Youngstown) of the Carnegie-Illinois Steel Corporation. One of four Whitcomb Industrial Diesels operating here.

Whitcomb Industrial Diesels Tailor-Made For Steel Mills

ewest type Whitcomb Industrial Diesels include many special features esigned to provide increased efficiency, easier operation, lowered ruling and switching costs.

ypical refinements include greater visibility through scientific window rrangement, a spacious, draft-free cab. Batteries are located at the dès for easy access and servicing. Bulk heads between engines and enerators protect the latter from excessive engine heat. Safety step ells provide extra protection for switchmen.

s a first step toward cutting your haulage and switching costs, write day for complete information on the Whitcomb Industrial Diesel ne — Diesel electrics from 25 to 95 tons; Diesel mechanicals from to 30 tons.

Most any switching or hauling assignment is easy for this powerful 80-ton Whitcomb Diesel locomotive in its steel making job. Compact, mobile, low-cost power speeds production.

There is no power cheaper than Diesel; no locomotive finer than a Whitcomb.

THE BALDWIN GROUP

THE WHITCOMB LOCOMOTIVE CO.

ROCHELLE, ILLINOIS

Subsidiary of

THE BALDWIN LOCOMOTIVE WORKS

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FEBRUARY, 1950

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... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

(1) Small Motor Selection

A 4-page small motor selector is available. The first page of the booklet is devoted to explaining why there are different types of fractional horsepower motors, and the factors to be considered in selecting the right motor for the application. The center pages, which open to form a large chart, present in tabular form the various types of small motors, together with complete data concerning horsepower range, speed characteristics, torque, reversibility, bearings, mountings, and application. Typical speed-torque curves for various types of fractional horsepower motors are included, together with information on specialized standard designs for specific applications, such as stokers, washing machines, hoists, etc. (B-3075-C). Westinghouse Electric Corp.

(2) Sectional Conveyor

A new bulletin has been announced which gives an illustrated description of the recently-introduced Hewitt-Robins sectional conveyor. This unit, easily assembled in the field, consists of a head (drive) section, a tail section and any desired number of intermediate truss sections to form a conveyor of any length up to limitations of the belt. Made in widths of 18 in., 24 in., 30 in. and 36 in., the intermediate truss sections are 6 ft 6 in., 15 ft 6 in., 18 ft 6 in. and 21 ft 6 in. long by 24 in. deep, and also 24 ft long by 42 in. deep. Both depths can be used on the same length of conveyor by means of a transition section 24 in. deep at one end, tapering out to 42 in. deep at the other. Bent supports, for setting the conveyor on a grade, range from 4 ft deep to 50 ft deep or more. A protective decking of 16-gauge curved plate forms a protective separation between carrying and return strands of the rubber belt. Two types of takeups are available: protected screw type for conveyors up to 200 ft long, vertical gravity type for longer installations. (132). Robins Conveyors division, Hewitt-Robins, Inc.

(3) Synchronous Generators

A new 8-page bulletin on "Tri-Clad" high-speed synchronous generators is available. The bulletin deals with generators for standby, portable, and prime source power in wide-spread fields of application. Profusely illustrated, it gives three typical installation stories, describes Tri-Clad protection, and tells about construction features, mechanical modifications, and performance data. Ranges from 12½ kva to 1250 kva, and speeds from 1800 rpm to 514 rpm are covered. (GEA-5415). General Electric Co.

(4) Bronze Bar Stocks

A 6-page bulletin, listing sizes and weights of cored and solid "Tiger" bronze bars, shows the physical properties of "Tiger" bronze and describes the many uses and advantages of this exceptionally wear and shock resistant, anti-frictional material. National Bearing division, American Brake Shoe Co.

(5) Versatile Anti-Rust Material

The publication of a 16-page, illustrated booklet is available providing interesting descriptive data on Oakite special protective oil, a material which is designed to give semi-permanent rust protection to metal parts during production, in storage or while awaiting shipment. The booklet describes the protective oil as an efficient rust-preventive oil of extremely low viscosity which imparts a thin, protective film to ferrous surfaces, resisting moisture, humidity, perspiration, residues and acid fumes. This film does not alter dimensions or surfaces of finely finished parts, nor is it necessary to remove it for gauging and similar inspection procedures, or for soldering or welding of light-gauge metals. It displaces water or moisture on metal surfaces. When rinsed parts are immersed in this oil, water sinks to the bottom of the tank, thus prolonging solution life. Under ordinary circumstances, the exceptional water-dispelling action of this material is said to eliminate the need for pre-drying of parts after rinsing or degreasing and before applying the protective oil. Besides providing interesting data on efficient anti-rust procedures, the booklet also features a special flow chart showing strategic points along the production line where this material may be applied effectively. (F. 7708). Oakite Products, Inc.

(6) Diesel Fuel and Lubricants

"Diesel Engines — Fuels and Lubricants," a booklet recently compiled is available. The rapidly expanding use of diesel engines in modern industry has inspired publication of this information and data. In preparing this text a special effort has been made to use language which would be clear to the layman while at the same time satisfying the needs of those who are particularly interested in more detailed technological explanations of the functions, capabilities and performance of specialized fuels, lubricants and additives. Sinclair Refining Co.

(7) Sleeve Bearing Speed Reducers

Engineers and designers can select Falk parallel shaft sleeve bearing speed reducers quickly and easily by using a recently released bulletin. This improved engineering bulletin is designed to provide complete engineering data on parallel shaft units in an easy-to-read handy form. Engineering data has been condensed into one bulletin which simplifies the procedure confronting an engineer when using product bulletins. The information contained in this bulletin supersedes all previous material issued concerning these parallel shaft sleeve bearing units. (1110). Falk Corp.

(8) Grinding Standards and Practices

Three new pocket size manuals, the result of work by various standards committees at Allis-Chal-

mers have just been released. One pertains to grinding standards, the other to grinding practices and the third is a trucking manual. The 32-page grinding standards booklet provides supervisory personnel with an outline and explanation of those standards which have been established to assist in assuring safe, trouble-free grinder operation. It covers portable, stand, tool, surface, external cylindrical, internal, and centerless grinders as well as mounted points and cut-off wheels. It lists the responsibilities of the purchasing department, safety organization, foremen, tool cribs, maintenance department and employes in connection with their use. The 20-page grinding practices manual designates rules and safe practices for the various grinders mentioned in the standards manual. It is written primarily for the worker and is illustrated with appropriate cartoons. It also carries helpful tables of correct revolutions per minute for specified surface speeds and decimal equivalents. The 20-page trucking manual describes safe practices for the various shop trucking operations at Allis-Chalmers. While the major portion of the booklet is devoted to general safe practices in the mechanical transportation of material, it does not overlook safe procedures in the manual handling of material. It, too, is enlivened by humorous cartoons. Members of the standards committees at Allis-Chalmers represent the various plant divisions and are appointed by the works' safety council, the company's top-level safety planning agency. Allis-Chalmers Manufacturing Co.

(9) Chromium Chemicals Handbook

A fact-filled, 32-page handbook on chromium chemicals, clearly depicting their general use and diversified applications in more than 17 different industries, has just been prepared. Spiral-bound, of 8½ in. x 11 in. size for convenient filing, the brochure presents complete yet concise data on bichromate of soda, its manufacture, and its principal uses. Among the applications cited in which this specialized Diamond chemical is advantageously employed are its utilization as a corrosion-resistant treatment for tin plate and as a means of inhibiting corrosion in water-cooled or water-circulating equipment. Similar information is also given for Diamond sodium chromate and bichromate of potash. In addition, the booklet discusses six methods of analyzing sodium bichromate. Supplementing this information are helpful charts and tables covering equivalent weights, conversion formulas, tank capacities and graphical data. Diamond Alkali Co.

(10) Roller Chains

"Unusual Applications of Roller Chains" is a title of a bulletin which is available. The material for this 24-page bulletin, assembled with the help and cooperation of designers throughout the country, suggests the broad application of roller chain by means of a representative showing of very unusual applications. Each application is described, illustrated with photos and, in the case of complicated machinery, with simplified working drawings. (49-2). Chain Belt Co.

(11) Hard Surfacing

A new bulletin, briefly describes the benefits of hard surfacing by fusion welding and the different types of rods which are available to meet the varied requirements of industrial applications. For each of the described electrodes in the article there is a corresponding Amsco electrode. The booklet is a reprint of a technical article entitled: "Hard Surfacing by Fusion Welding" written by Howard S. Avery, Research Metallurgist. American Manganese Steel division of American Brake Shoe Co.

(12) Water Softening

While considerable information is available on the performance of organic zeolites in the sodium cycle with brine regeneration, comparatively few reports have been published on the results obtained from such zeolites in the hydrogen cycle with acid regeneration. A paper on this subject was delivered to the Tenth Water Conference of the Engineers' Society of Western Pennsylvania at Pittsburgh on October 18, 1949, by V. J. Calise, technical director of Graver Water Conditioning Co. In addition to presenting the operating data from several commercial hydrogen zeolite installations based on Mr. Calise's experience, the paper also explains the applications of acid-regenerated zeolites, compares sulfonated coal type and resin type zeolites, and discusses the various factors involved in establishing conclusions as to the effectiveness of this method of water softening, including silica removal. The paper has recently been published as an article, with tables of results obtained and charts showing the characteristics of these zeolites. (TA-115). Graver Water Conditioning Co.

(13) Metal Working Facilities

Just completed is a handy file folder for engineers and estimators to use when considering Brandt's stamping and metal working facilities. For 60 years this organization has produced specialized metal work. In recent years, primary emphasis has been placed on automotive stampings, heavy weldments and pressed steel shapes . . . for manufacturers all over the country. It is felt that this new file will save much valuable time. It is designed for reference; it contains a complete analysis of production facilities, including a detailed list of plant equipment. Charles T. Brandt, Inc.

(14) Dust Suppression

Two new bulletins, covering the popular Whiting wet-type "Hydro-Clone" dust and fume suppressors have just been published. One of these 4-page bulletins describes the horizontal type "Hydro-Clone;" the other, the vertical type. Both bulletins contain cut-away illustrations which explain operation. Dimension tables for the various size units, and installation photos are also included. These suppressors were first developed for foundry use and have been extensively applied to shake-outs, sand-handling, and hot blast systems. In recent years their use has become popular in a wide variety of plants — in fact, they have been successfully applied wherever dust or fumes make working conditions either uncomfortable or dangerous. (FY-162 and 165). Whiting Corp.

(15) Power Distribution

Just published is the first of three catalogs which will be devoted to "Flex-A-Power," a six-member power distribution family that ranges in capacity from 50 to 5000 amp. This 40-page catalog is devoted to "LVD and SAC Flex-A-Power," the heavy duty members of the family which are used as main feeders. It describes construction details, accessories, engineering data and application information. It makes a comparative analysis between "Flex-A-Power" and wire and conduit on a basis of cost and

performance. Printed in three colors, this catalog contains a full listing of all parts, and gives complete instructions on how to specify, order, price and install. (TEB-1). Trumbull Electric Mfg. Co.

(16) Portable Cable

A new 56-page manual on "Hazacord" flexible cords and portable cables has just been published. Complete technical information and dimensional data are given covering the entire range, from the smallest 300-volt type SJO cord to the largest 15,000-volt shovel cable, including welding cables, jumpers, motor leads and mining cables. Tables of current carrying capacities, resistance values and their correction factors are shown. An important section of this bulletin describes methods of splicing the various portable cable constructions. Clear diagrams show each step in the splicing procedure and are sufficiently complete to cover the most complicated portable cable construction. Constructions of the various cables are discussed in detail, with particular emphasis placed on the permanent protection provided by the tough, flame-resistant "Hazaprene ZBF" sheath. Typical test values are given for the insulations and sheath to assist users in choosing the proper construction for specific applications. Fully illustrated with actual photographs taken in the plant and in the field, this booklet also describes the research and manufacturing methods employed, as well as the many difficult services in which flexible cords and portable cables are used. (H-420). Hazard Insulated Wire Works division of Okonite Co.

(17) Alloy Castings Reference Chart

Publication is announced of a reference chart on stainless, corrosion and heat-resistant alloy castings. This 6-page folder contains a comprehensive analysis of stainless, corrosion and heat-resistant alloy castings. It is considered, in the field, to be the most accurate and up-to-date chart available at this time. It contains in detail, alloy types, type numbers, as well as comparative designations of the Alloy Castings Institute, and others. In addition, it gives the properties of these alloys at room temperature and in high temperatures and discusses the applications of these alloys in detail with pertinent remarks. It also gives the nominal analyses of the alloys as well as miscellaneous data on corrosion and heat-resistant alloys. Cooper Alloy Foundry Co.

(18) Compressibility Charts

A new bulletin is available — "Compressibility Charts and Their Application to Problems Involving Pressure-Volume-Energy Relation for Real Gases." These charts will be of great value to anyone working with gases. (P-7637). Worthington Pump and Machinery Corp.

(19) Vertical Speed Reducers

A new bulletin has just been issued announcing two new types of vertical speed reducers. These worm gear speed reducers, types NU and ND, employ all of the experience gained in years of manufacture, application and operation of their predecessors. They employ heavier gear shaft bearings and have increased bearing span while the overhung length of the shaft extension is reduced. The booklet describes these speed reducers in detail and contains charts showing dimensions and capacities. (125). Cleveland Worm and Gear Co.

(20) Gear Motors

Foote Brothers Gear and Machine Co. and Louis Allis Co. have jointly brought out a new line of gear motors. Seventeen sizes in single, double and triple reductions give A.G.M.A. output speeds from 780 rpm down to 7.5 rpm, with a capacity range of from 1 through 75 hp for A.G.M.A. I, II or III service. The motor portion is built by Louis Allis and the gear unit is manufactured by Foote Brothers. (GMA). Foote Brothers, Gear and Machine Corp.

(21) How Rolls Are Made

One of the first booklets ever produced describing the manufacture of cast steel and chilled or alloyed cast iron rolls is available. Through pictures and factual information, the making of rolls is discussed from beginning to end. The booklet does not attempt to give a technical treatise on roll manufacture, but gives a picture story that everyone can understand. Every man interested in the rolling of steel should have this booklet in his file. Mackintosh-Hemphill Co.

(22) Clean Water

Literature is available telling of a new system of water purification. This literature will show engineers of industry how they can take every precaution to save water and stop forever the pollution of this valuable asset. It describes how this can be prevented by specially designed treatment systems. Gale Oil Separator Co., Inc.

PUBLICATIONS CURRENTLY OFFERED by Iron and Steel Engineer Advertisers

ITEM	COMPANY	BULLETIN	DESCRIPTION
50	AIR REDUCTION SALES CO.	CATALOG NO. 8	Helpful booklet on Airco arc welders.
51	ASKANIA REGULATOR CO.	BULLETIN 139J	Describes in detail the jet pipe control principle.
52	BAILEY METER CO.	BULLETIN 211	"Bailey Smoke Density Recorder" tells how to erase your smoke troubles with the Bolometer.
53	BEDFORD FOUNDRY AND MACHINE CO.		Catalog available on Bedford cranes with capacities from 5 to 150 tons.
54	BLOOM ENGINEERING CO.		Bulletin available giving full details of the Bloom tempered flame burner.
55	BRANDT, INC., CHARLES T.	FILE NO. 509	Reference file of specialized facilities of the Brandt Co.
56	BROWN INSTRUMENT DIVISION, MINNEAPOLIS-HONEYWELL REGULATOR CO.	SPECIFICATION SHEET 112	Detailed information on the Brown line of temperature controllers.
57	BROWNING AND CO., INC., VICTOR R.	BULLETIN "S"	Describes Browning mill type cranes.
58	CLARK CONTROLLER CO.	BULLETIN 6200	Contains information on Clark control centers.
59	CLEVELAND WORM AND GEAR CO.	CATALOG 300	Full description on the Speedaire unit.
60	COLUMBIA ELECTRIC MANUFACTURING CO.	CATALOG IS-700	Describes motor generators for electroplating and electrocleaning.
61	CROCKER-WHEELER DIVISION, ELLIOTT CO.	BULLETIN SL 620-1	Describes the new Crocker-Wheeler auxiliary mill motor.
62	CRANE CO.	CIRCULAR AD-1761	Contains all essential specification data on Crane valves.
63	CROUSE-HINDS CO.		A convenient reference book is available from which to select proper Condulets for required applications.
64	DE LAVAL STEAM TURBINE CO.	CATALOG 4202-25-R	Gives full information on De Laval turbines.
65	ELECTRIC CONTROLLER AND MANUFACTURING CO.	BULLETIN 942	Describes EC&M tab-weld plate resistors.
66	FAWICK AIRFLEX CO., INC.	BULLETIN 300	Gives the advantages of Fawick industrial clutch and brake units.
67	FURNACE ENGINEERS, INC.		Bulletin available telling how F.E.I. technique has made ordinary methods.
68	GENERAL ELECTRIC CO.	BULLETIN GEA-4469	Gives details on how better-cooled better-protected d-c motors can help cut costs in your mill.
69	HOMESTEAD VALVE MANUFACTURING CO.	REFERENCE BOOK NO. 39-3	Full particulars available on Homestead's lever-sealed valves.
70	LEEDS AND NORTHRUP CO.	CATALOG N-33B	Contains up-to-date material on all Rayotubes.
71	LINK-BELT CO.	CATALOG 2550	Includes complete data on Link-Belt ball and roller bearings.
72	LINTERN CORP.	BULLETIN AC 4912	Full information available on the Lintern aire-rectifier.
73	NATIONAL CARBON DIVISION, UNION CARBIDE AND CARBON CORP.		"Graphite Stool Inserts for Big-end-down Molds," a reprint available giving a clear, concise picture of graphite stool inserts.
74	OKONITE CO.	BULLETIN IS-1035	Describes in detail the Okolite advantages over lead-covered as well as ordinary rubber-insulated cables.
75	PENNSYLVANIA TRANSFORMER CO.	CATALOGS NO. 349 AND 1049 TRANSFORMER BOOKLET NO. 1492	Information available on Pennsylvania's complete line of transformers.
76	POOLE FOUNDRY AND MACHINE CO.		Catalog gives full description and engineering data.
77	POST-GLOVER ELECTRIC CO.	BULLETIN NO. 500	Gives detailed information on P-G resistors.
78	TAYLOR CHAIN CO., S. G.		New booklet available containing complete data on all types of welded chain.
79	TRACERLAB, INC.	BULLETIN E	Describes the uses and advantages of the new Tracerlab beta gauge.
80	WAGNER ELECTRIC CORP.	BULLETIN IU-40	Full information available on Wagner "Full-Control" hydraulic brakes.
81	WARE FUSE CORP.		"Look Inside," a booklet which describes Ware "Hi-Lag" renewable fuses.

Book Reviews

▲NEMA has recently published the following standards, and copies are available for immediate distribution:

NEMA STANDARDS FOR HYDRAULIC TURBINES AND GOVERNORS (DEFINITIONS AND NOMENCLATURE). Publication No. HT1-1949. 28 pages, $1.40.

NEMA STANDARDS FOR INDUSTRIAL CONTROL, Publication No. IC1-1949. 116 pages, $5.00.

NEMA STANDARDS FOR VULCANIZED FIBRE, Publication No. VU1-1949. 12 pages, $0.50.

▲ The average heat content of the various coals produced in the United States are listed in an information circular issued by the Bureau of Mines. These heating values, compiled both by rank, or class, and according to the 27 states in which they were mined, are useful in making general comparisons between the different coals, and between coals and other fuels.

A free copy of Information Circular 7538, AVERAGE HEATING VALUES OF AMERICAN COALS BY RANK AND STATES, may be obtained by writing to the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

▲ The fourteenth edition of MACHINERY'S Handbook has just been issued by the Industrial Press, 148 Lafayette St., New York 13, N. Y., cloth bound, 1911 pages, 4½ x 7 in., price $7.00. The book was edited by Eric Oberg and Franklin D. Jones and contains basic information, data and formulae for use in designing and building any type of machine or mechanical device. It is basically a reference book which is broad in its application to the machine design field, although specialized in character. The book has been brought up to date and for example includes the new unified and American Standard Screw System which was recently adopted to permit interchangeable threads in the United States, Canada and the United Kingdom.

▲COAL, COKE AND COAL CHEMICALS by Phillip J. Wilson, Jr. and Jos. H. Wells has just been issued as one of the chemical engineering series sponsored by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $8.00, 500 pp, 6 x 9 in. cloth bound. This book fulfills a need long felt for a modern textbook on coking practice which will cover the strides that have been made in this field in the last few years. The book is also of value to people outside the industry such as business men who are interested in the operations and possibilities in coal carburization.

The book covers first the subject of fuels and their combustion, coal, coal preparation, the coking processes and the final recovery of the coal chemicals. In addition, chapters are devoted to the carbonization process that are carried on in units other than by-product and beehive ovens, such as gas retorts and the low temperature carbonization processes. Economics and trends in industry are also covered. The book is well illustrated with flow diagrams.

▲ ENGINEERS DICTIONARY—SPANISH-ENGLISH AND ENGLISH-SPANISH by Louis A. Robb will be of interest to the engineers and suppliers who have contact with Spanish speaking countries and personnel. The book covers particularly civil, electrical, mechanical mining, shipbuilding and oil field terms. Book may be obtained from John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 664 pp, 5½ x 8⅜ in., price $12.50.

▲ Those who are interested in selling to the federal government will find the book "Selling to the Federal Government," published by the Bureau of National Affairs, Inc., 1231 Twenty-fourth St., N.W., Washington 7, D. C., of value. Book is paper bound, 8¼ x 11 in., 348 pp, price $5.00. This book is a comprehensive guide, supplying the methods and procedures followed by the federal government in setting procurement requirements for its civilian and military establishments.

▲ ANALYTICAL MECHANICS OF GEARS by Earle Buckingham has been issued by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y., cloth, 6 x 9 in., 546 pp, price $10.00. This book gives a complete outline of the fundamental relationships which form the design of all types of gears. Although it is not a text on gear design, it is a source and reference which will lead to the effective design of gears for all purposes. The author writes that an appropriate sub-title could well be "Final Report of the ASME Special Research Committee on Worm Gears and the Strength of Gears." This book will probably prove to be one of the outstanding works of recent times in the field of gearing. The book deals primarily with the nature of gear action, tooth forms, influence and nature of friction, the various conditions that affect the intensity of dynamic loads, strength of gear teeth as well as the resistance of various combinations of materials to wear. Material includes spur and helical gears on parallel shafts, bevel and spiral bevel gears on intersecting shafts, and spiral, worm and hypoid gears on non-parallel and non-intersecting shafts. The book is advanced and uses a mathematical and analytical approach.

▲ HOT TINNING by W. E. Hoare has recently been issued by the Tin Research Institute, Inc., an international organization, and may be obtained in the United States from the association at 492 W. Sixth Ave., Columbus, Ohio. This book provides complete working instructions for the production of hot-tinned coatings on fabricated articles and components, and is essentially a practical manual for the operator. The publication contains 112 pp, 47 illustrations, and may be obtained free of charge by writing the Tin Research Institute.

▲ A.S.T.M. SYMPOSIUM ON LUBRICATION OF HIGH-SPEED TURBINE GEAR EQUIPMENT has just become available in printed form (Technical Publication No. 92). Copies of this 32-page publication, paper cover, can be obtained from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $0.75 each.

▲ The second edition of CONVEYORS AND RELATED EQUIPMENT by Wilbur G. Hudson, was recently issued by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., cloth bound, 468

pages, 5¾ x 9 in., price $7.00. This book is a guide to the factors which should be considered when buying equipping, operating and maintaining conveyors and similar devices. Of particular interest to the steel mill engineer are the steel plant equipment items such as the skip hoist which is covered in the book.

▲DYNAMIC EQUIPMENT POLICY by George Terborgh, a study of Machinery and Allied Products Institute, has recently been published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Book is cloth bound, 6 x 9 in., 290 pp, price $3.75. This book describes the principles of sound re-equipment analysis and illustrates the procedure by actual examples. Based on such analyses, it is often possible to show that replacement of existing equipment by newer and more modern designs can result in very appreciable economies over what would be obtained by trying to operate with existing equipment until such existing equipment is completely obsolescent.

▲HARDENABILITY AND STEEL SELECTION by Walter Crafts and John L. Lamont has been issued by the Pitman Publishing Corp., 2 W. 45th St., New York, N. Y. Book is cloth bound, 6 x 9 in., 279 pp, price $5.50. This book is an up-to-date summarization of the current hardenability theories and calculations that are well supported by factual data. The book also is a practical exposition of the metallurgical theory which has largely developed since 1940, and which has been responsible for steel being purchased by hardenability instead of by chemical composition. Calculations of hardenability are based on four steps, quenching rates, depth of hardening and quenching, softening, toughening and tempering. The book also covers effects of chemical composition on the resulting mechanical properties.

▲WELD DESIGN by Harry D. Churchill and John B. Austin was recently published by Prentice Hall, Inc., 75th Ave., New York 11, N. Y., cloth bound, 5½ x 8¾ in., 216 pp, $6.65. This book is a concise volume on welded machine-base design. Most machine design textbooks cover cast machine bases, but give little information on the welded type base, and this book fulfills the need for information on this subject, which is treated from both the practical and theoretical standpoint.

▲FOUNDRY SCIENCE by Harry A. Schwartz, was issued to interpret the findings of the scientist to the engineers specializing in foundry practice. Its object is to correlate the fundamental sciences with the processes encountered in practice. The book is basically scientific and technical, although most of the mathematical complexities have been eliminated, or simplified. This book is one of the Pitman Metallurgy Series for which Frank T. Sisco is advisory editor, and is published by the Pitman Publishing Corp., 2 W. 45th St., New York, N. Y., price $6.50, cloth bound, 286 pp, 6 x 9 in.

▲TEXT IN PATTERNMAKING by Alexander V. Hanel has been issued by the Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1, Wis., as a textbook to fit the needs of students and apprentice pattern-

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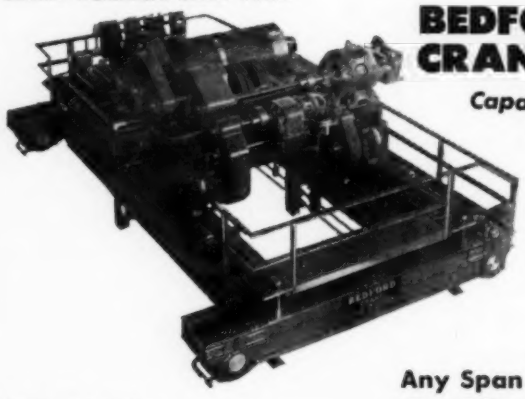

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makers and journeymen. The book is cloth bound, 314 pp, 6 x 9 in., price $2.96. It is divided into two parts, the first part has general information and pertinent specific technical data, and the second part is a series of jobs designed to give the student training in fundamental skills and procedures in a logically graduated sequence.

▲ PB 97403, GATING SYSTEMS FOR METAL CASTING, 16 pages, is available at $2.50 in photostat, $1.75 in microfilm. Orders should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C. accompanied by check or money order payable to the Librarian of Congress.

▲ CORROSION OF IRON AND STEEL BY INDUSTRIAL WATERS AND ITS PREVENTION was prepared by The Industrial Waters (Corrosion) Sub-Committee of the British Iron and Steel Research Association and published by The Iron and Steel Institute as Special Report No. 41.

The report is divided into four sections.

The report also contains a short bibliography and a list of nearly 100 references to papers in the English language. The booklet contains 56 pages and some 20 illustrations and may be obtained from the Iron and Steel Institute, 4 Grosvenor Gardens, London, S. W. 1, price 5 shillings.

▲ The first authoritative published collection of S-curves for the main types of wrought steel in current use is contained in the ATLAS OF ISOTHERMAL TRANSFORMATION DIAGRAMS now issued by the British Iron and Steel Institute as Special Report No. 40.

The report is published by the (British) Iron and Steel Institute, 4, Grosvenor Gardens, London, S. W. 1, price 15 shillings to members and 25 shillings to non-members.

▲ The 1950 edition of Section Eight of the ASME Boiler Construction Code covering rules for the construction of unfired pressure vessels has recently been published by The American Society of Mechanical Engineers. Compiled by the ASME Boiler Code Committee, H. B. Oatley, chairman, it embodies all the revisions in the code that have taken place since the 1946 edition.

The 1950 edition covers carbon and low-alloy steels only. The rules for non-ferrous metals, cast-iron and high alloy steels are now in preparation and will be added to the present volume. The stress tables are based on a safety factor of four instead of five as in the 1946 code. The 1950 code therefore allows the manufacturer more flexibility and cuts costs, permitting the construction of lighter vessels. With a table of contents (the 1946 code didn't have one) as well as an index, the new volume is arranged for easy reference and is more workable for designers and inspectors.

The ASME Unfired Pressure Vessel Code has now been adopted by 38 states, Canada, Hawaii, Puerto Rico and the Panama Canal Zone as well as many cities in non-code states in this country. It is available from the society, 29 West 39th Street, New York, N. Y., at $3.50 a copy.

▲ NEMA has recently published the following standards, and copies are available for immediate distribution: NEMA STANDARDS FOR ARMORED CABLE AND ARMORED CORD, Publication No. AC1-1949. Information concerning the conductor assembly, armor, physical and electrical tests, markings and type designations of armored cable and armored cord, Types AC, ACH, ACU, ACL, ACHL and CA is contained in this new NEMA standard. 22 pages, $1.00.

▲ NEMA STANDARDS FOR MOTORS AND GENERATORS, Publication No. MG1-1949. This is a new and completely revised edition of the NEMA Standards for motors and generators, Publication No. 45-102. The first half of the book covers ratings, dimensions, tests and performance characteristics, frame assignments and application data for fractional- and integral-horsepower motors rated 200 hp and less. The second half of the book is devoted to definite-purpose motors, integral-horsepower and synchronous motors, direct-current generators, synchronous generators, high-frequency industrial motors and motor-generator sets. 208 pages, $5.75.

▲ NEMA STANDARDS FOR SHUNT CAPACITORS, Publication No. CA1-1949. This publication contains standards for the rating, manufacturing, testing, application and operation of (1) capacitor units of one-half kva and larger for power factor improvement and other low-frequency alternating-current applications and (2) assemblies of capacitor units with accessories and control to form complete capacitor installations. It is a complete revision of and supersedes the NEMA Standards for Shunt Capacitors, Publication No. 45-100. 28 pages, $1.50.

▲ Smoke Prevention Association of America, Inc., announces publication of all the papers presented at the 1949 meeting of the Smoke Prevention Association of America, Inc., which have been assembled into a book now available to industry. The contents range from a description of steel industry activities regarding air pollution to discussion of smoke ordinances. Papers presented are by consulting engineers, industry engineers, smoke inspectors, railroad engineers, equipment manufacturers, and others. Price: $2.00. A 188 page book, size 8½ x 11, paper bound, it contains 23 articles with 22 illustrations. Orders should be sent to John Paul Taylor, publisher, 520 Pleasant St., St. Joseph, Mich.

▲ An extremely interesting chart called IRON ORE FLOW MAP which shows movement of Lake Superior, eastern and imported ores to the locations of the consuming furnaces for the year 1947 has been issued by the Lake Superior Iron Ore Association, 1170 Hanna Building, Cleveland 15, Ohio. The prices for this map are $1.50 for a single copy and $1.00 each postpaid for five or more. A three per cent sales tax is to be added for purchases within Ohio. The map is in color and is 24 x 32 in.

▲ Iron blast furnace slag, once considered a waste product of the iron and steel industry, in recent years has been developed into a useful raw material and now is widely used in road construction, for railroad ballast, as aggregate in concrete, and for other purposes, according to a Bureau of Mines bulletin released recently for sale through the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

▲ Copies of Bulletin 479, IRON BLAST-FURNACE SLAG: PRODUCTION, PROCESSING, PROPERTIES, AND USES, may be obtained only from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 75 cents each (paper covers)

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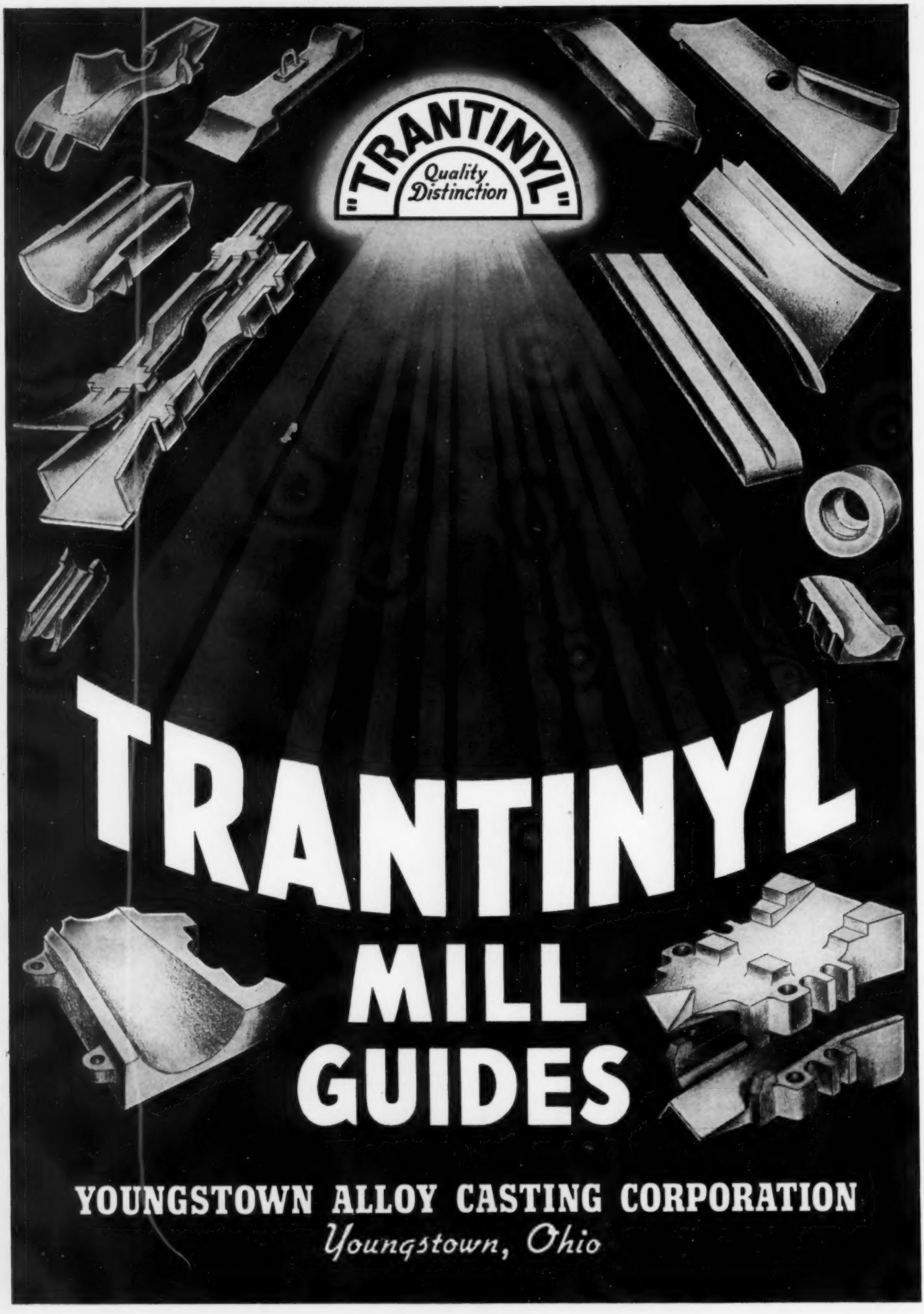
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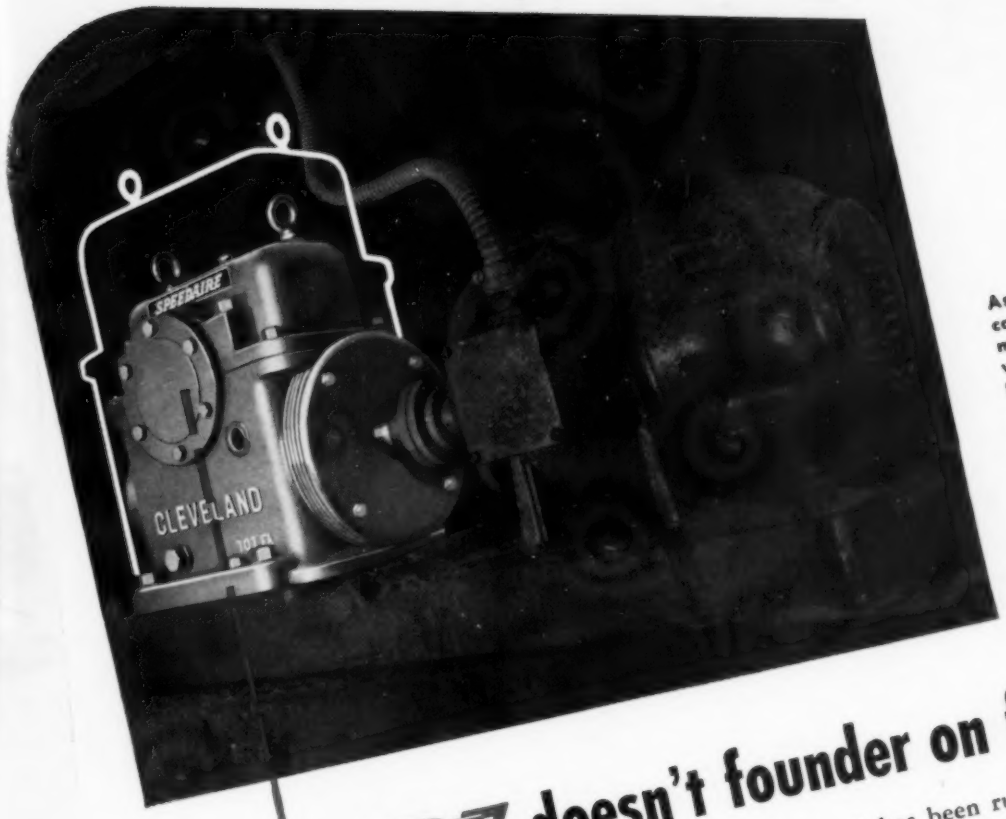

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Photograph by courtesy of the Packard Motor Car Company.

SPEEDAIRE doesn't founder on foundry sand

FOR well over a year, this Speedaire unit has been running continually, driving a spiral conveyor in the Packard Production Foundry at Detroit. As the photograph reveals, operating conditions are quite severe, both motor and reducer being subjected constantly to sand and grit.

Speedaire was selected for this service because of the three-way saving it offered, compared to the conventional worm gear speed reducer. Speedaire is 23½% lighter in weight, takes 38% less space and costs 12½% less money than the standard unit required to do the job.

Speedaire is Cleveland's fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Co., 3278 East 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

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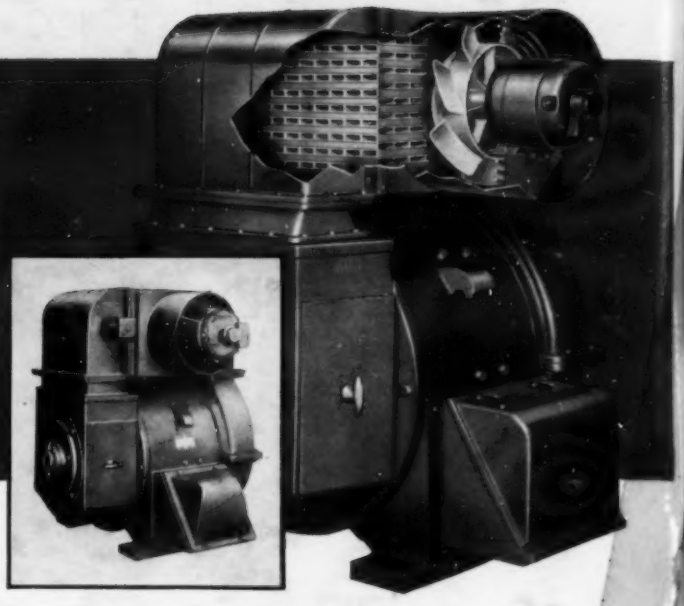


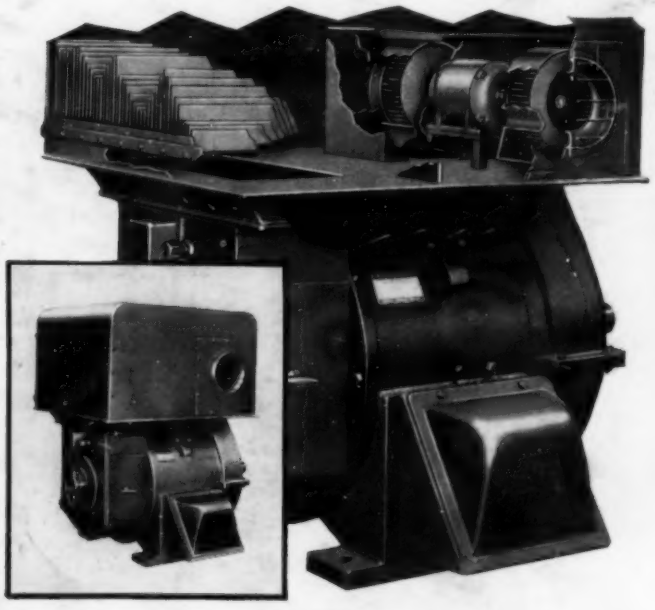
unit-cooled D-C MOTORS

Single-blower type for normal speed operation In this standard G-E motor, the unit cooler consists of alternate air passages placed at right angles to each other. Clean motor air, kept in motion by a fan on the main motor shaft, circulates through one set of passages in an enclosed system. Cool outside air, drawn into the cooler by a blower separately motor-driven, flows through another set of passages and absorbs the heat from the internal air stream. Motor air, never in contact with contaminated outside air, is always clean.

When you need reliable d-c power on dirty jobs, without worrying about maintenance, here's the answer—General Electric standard, totally enclosed, unit-cooled d-c motors. Atmospheric conditions that soon stop an open motor—dust, dirt, dampness, metal particles or oily vapors—can't affect their operation. Motor failures are reduced, machined output increased.

Installation is no problem. Motor and cooler, as a unit, come ready to install, with no auxiliary ventilating fixtures needed. Easy access to commutator, brushes and brush rigging simplifies maintenance. And power cost is less, especially where you use a wide speed range, because motor heat is quickly dissipated.

Better protected and better cooled, these tough G-E motors are available in ratings from 15 to 200 hp. See your G-E representative for more information, or write for Bulletin GEA-4469. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Double-blower type for continuous low speeds New—a totally enclosed standard G-E motor that can't run a fever! Without danger of overheating, it delivers full torque continuously, even at very low speeds. Key to its operation is a new development—ventilation entirely independent of motor speed. Two blowers, mounted on opposite shaft extensions of a single auxiliary motor running at constant speed, provide full ventilation at all times. One circulates internal air and the other external air through alternate vertical passages.

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